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STEEL CONSTRUCTION

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PHILADELPHIA.

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LOWE WATER GAS APPARATUS.

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VOL. CI., No. 5. **NEW YORK, AUGUST 3, 1914.** WHOLE No. 2,043.

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Some Statistics of the Gas Industry.

[By GILBERT COLVILLE SHADWELL, Statistican, National Commercial Gas Association.]

The compilation of reliable data and statistics in so large a country as the United States is, of necessity, a difficult task. That there will be errors is a foregone conclusion. Such errors may be brought about in several ways; an example would be incomplete data furnished, due probably to a mistaken idea that figures given out may be detrimental to the company; or from a lack of system in not having at hand the information asked. This may often necessitate an estimate (not always correct) by the person seeking the information. Further, consolidated gas and electric companies may not always be able to apportion exactly the capital, and so forth to each division of their organization. In this connection it will be of interest to learn that the National Commercial Gas Association has in hand the systematic compilation of all such data that will help companies by showing what general and specific progress is being made, and will bring before them the direction in which new business may be obtained.

At the present time the widest statistics available are those in the census reports and in the reports of the United States Geological Survey by Mr. Edward W. Parker. The figures and diagrams in this article are derived mainly from these reports, but it should be borne in mind that although undoubtedly sincere efforts have been made to give reliable data in the reports, estimates have had to be made in some cases. In fact, in reply to a letter from the Association, Mr. Parker states that in the case of the figures for gas used for fuel and for lighting, estimates had to be made in several instances. Although there may be some errors in the results the general figures show the progress made rather clearly and with a fair degree of accuracy. The diagrams in this article should be studied in every case, with the context. Readers should keep in mind that in Mr. Parker's report the figures include coke oven gas, whereas in the United States census report this is *not* included (except in a very few instances), but it does include acetylene, etc., as described. The statistics for the manufacture of gas given in the 13th (1910) census show figures for the manufacture of gas for illumination and heating purposes for the calendar year 1909. The general results of the census inquiry are summarized in tables presented in connection with the text, while other tables give statistics in detail by States. Special tables are also presented in which the statistics are classified according to character of ownership, size of establishment, number of wage earners, and prevailing hours of labor; while another set of tables give detailed information in regard to the quantity and value of the products, the mileage of gas mains and the number of stoves and heaters connected with the mains. The returns relate to the calender year 1909, or the business year which corresponds most nearly to that calendar year, and cover a year's operations, except for establishments which began or discontinued business during the year. It is mentioned that the word "establishment" generally represents a single plant, but in some cases two or more plants operated under a common ownership or for which one set of accounts is kept. If however, the plants included under one establishment are not all situated within the same city or State, the statistics have been separated in order that the results may be in accordance with the general method of the census report. In the introduction of the report details are also given of persons engaged in the manufacturing industries, but it is pointed out that the census did not make any attempt to ascertain the number of employess working certain hours per week nor the general details regarding hours of labor. Notes are given on the cost of manufacture and profits.

The classification "Gas—Illuminating and Heating" covers estabments making gas for sale for light, heat and power, including some establishments operated by municipalities. It covers the production of gas by various processes, including the destructive distillation of coal, wood, resins, oils or other carbonaceous substances; the action of steam upon incandescent carbon or carbon-containing substances; the volatilization, or cracking, of petroleum or petroleum distillates; and the action of water upon substances like calcium carbide. Mention is made that the figures do not include many residences, hotels and mercantile establishments having plants for making acetylene or other gas for light, heat and power, and many manufacturing and industrial concerns which make gas—usually "producer" gas—in large quantities for use as fuel in their own establishments. The gas produced in by-product coke plants is not generally mentioned in the report, but details of this are given in the treatise by E. W. Parker on "The Production of Gas, Coke, Tar and Ammonia at Gas Works and in Retort Coke Ovens and of Gas and Tar at Water-Gas Works in 1912," published at Washington in 1913. Details of establishments which sell gas which has been purchased from plants that manufacture it, have not been included. It thus appears that no duplication has crept in.

The number of merchandizing companies other than manufacturers was reported as being 51 in 1909, the total capital of those establishments was $15,297,324, and the quantity of gas sold by them was 3,273,618,000 cubic feet, having a value of $3,605,635. Their receipts from rents, sales of lamps and appliances, was shown as $19,843, and from all other products, $38,719. Establishments in the industry produce not only straight coal gas, straight water gas, carbureted water gas, mixed coal and water gas, oil gas, and acetylene gas, but also by-products tar, pitch benzol, hydro-carbons, ammonia water, sulphate, coke, cyanides and other products.

There is so much interesting and valuable information in these reports that special reference is desirable, if not essential for proper understanding of the whole subject.

The following figures are given in the United States census report on the manufacture of gas and show the progress made to 1909:

Year.	No. of Establishments.	Capital.	Value of all Products
1850.....	30	$6,674,000	$1,961,746
1890.....	742	258,772,000	56,987,090
1900.....	877	567,000,000	75,717,000
1905.....	1,019	725,000,000	125,145,000
1909.....	1,296	915,537,000	166,814,000

Diagram No. 1 shows the per cent. change in quantity of gas sold, cost of materials for gas manufacture, value of products, value of gas sales, wages and salaries paid, number employed in the industry, capital, number of plants, the average price of gas, and the per cent. change in gas ranges, oil and vapor stoves, and coal stoves and ranges sold by years.

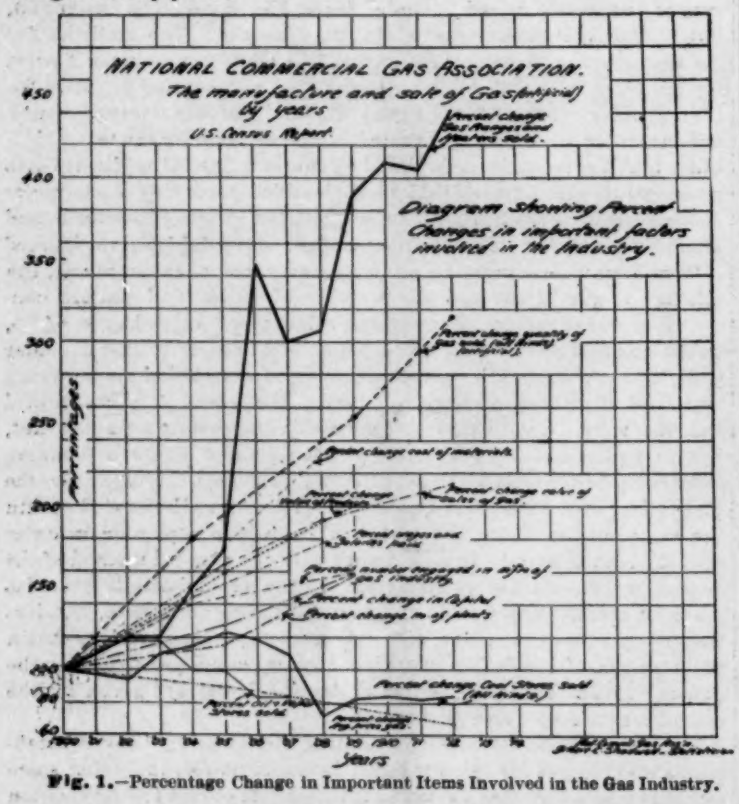
NATIONAL COMMERCIAL GAS ASSOCIATION.
The manufacture and sale of Gas (graphical) by years
U.S. Census Report.
Diagram showing Percent Changes in important factors involved in the Industry.
Percentages
Years

Fig. 1.—Percentage Change in Important Items Involved in the Gas Industry.

Considering the manufacturing side, the increase in the number of plants is not, of course, a real indication of the growth of the industry, in that in many cases previously existing plants have been absorbed by other companies. From the figures shown, however, and from the curves derived therefrom, the increase from 1900 to 1910 is about 40 per cent. in the number of establishments, as compared with 18 per cent. from 1890 to 1900. The increase in annual product was about 120 per cent. in 1900-1909, while from 1890 to 1900 the increase was about 33 per cent. The capital increase, as will be seen, was only a little greater in 1900-1909 than for 1890-1900. With regard to stoves, etc., sold, the actual figures (give by Mr. Barbour in his paper read before the Association, and since completed by him) show the following for 1900:

Coal stoves, etc., sold.....	3,480,000
Oil stoves, etc., "	300,000
Gas stoves, etc., "	200,000

The growth of the gas industry is indeed remarkable. The curve showing the per cent. sales of gas ranges indicates a wonderful increase, whereas the corresponding percentage curves for oil and coal heaters show a decline.

It is interesting to note the rise in price of wages and commodities compared with the fall of price in gas.

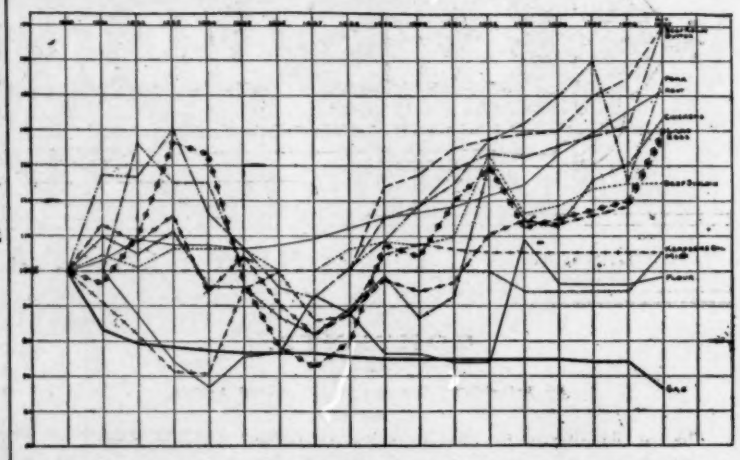

Fig. 2.—Showing the Percentage Rise in Commodities and the Fall in Price of Gas by Years.

In a paper by Mr. J. W. Lansley some comparisons are given from the above-mentioned sources, showing the comparison of the gas industry with other industries and have been put into a diagram (Fig. 3). The value shown under "Gas" is that for illuminating and heating purposes, and includes all plant capital.

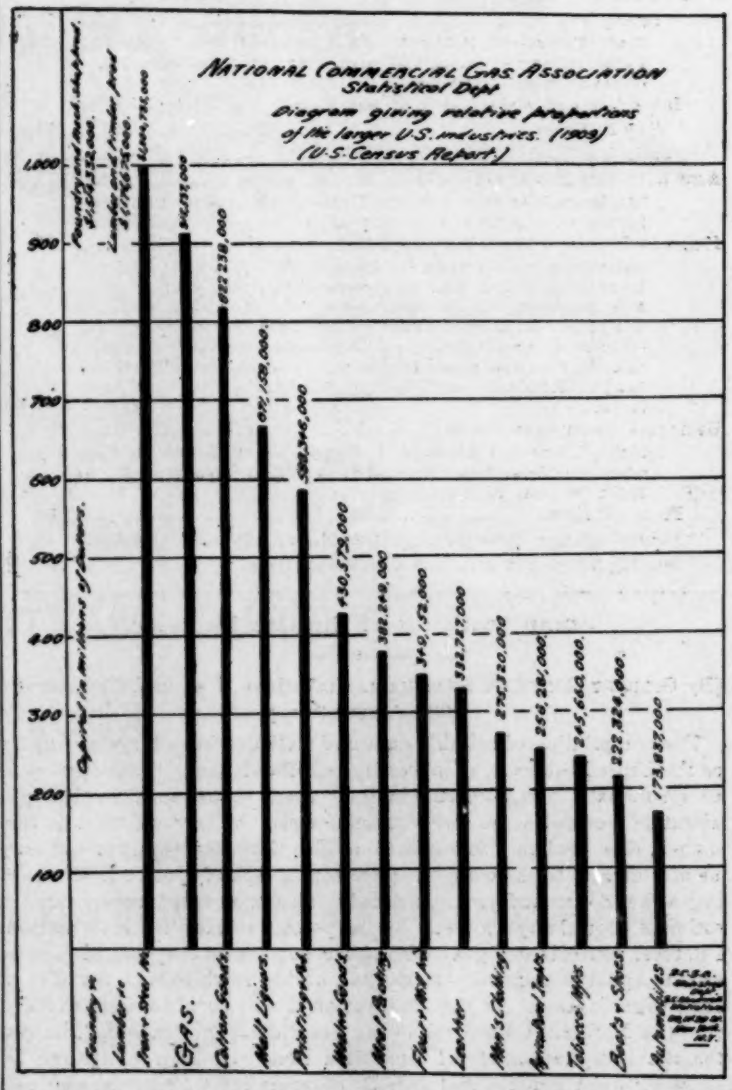
NATIONAL COMMERCIAL GAS ASSOCIATION
Statistical Dept
Diagram giving relative proportions of the larger U.S. industries. (1909)
(U.S. Census Report.)
Capital in millions of Dollars.
Gas.

Fig. 3.—Comparison of Gas Industry with Some Other Straight Manufacturing Industries.

The convenience and adaptabilty of gas for light, heat and power is recognized more fully each year. Moreover, it is believed that when later figures are available increase will be indicated to an even

more marked degree. It may be interesting in this connection to quote from the paper mentioned: "The annual product of the artificial gas industry in the United States during 1909 ($166,814,000, the value of the gas itself being $138,615,309) may be termed a gas bill of right smart size. It is greater than all the petroleum produced in this country during the same year ($128,328,487); greater than all the gold ($99,673,400) and silver ($28,455,200); it is over ($100,000,000 greater than the value of all the natural gas ($63,206,941); greater than the value of all the Pennsylvania anthracite coal mined in the same year ($149,181,587). It is practically two-fifths as great as the value of all the pig-iron ($419,175,000) or all the coal other than Pennsylvania anthracite ($405,486,177) taken from the earth during the same twelve months."

With regard to the effect of differential and sliding scale rates on the use of gas for fuel, it would appear from the figures and diagrams included in this article (taken from the United States Census, Mr. Parker's Report, from the N. C. G. A. *Proceedings*, and other sources) that such rates have had a beneficial effect on sales in this field. Here, of course, the factor of service rendered enters largely into account and the question of rates becomes one of great importance.

It is very difficult to judge how far the apportionment of gas for lighting and fuel given in Mr. Parker's report is correct. The Association has made inquiries of the United States Geological Survey on this matter but no satisfactory determination has been arrived at, other than that estimates had to be made in certain cases. The figures, therefore, had not been included in this article. It should be borne in mind in this connection, that for domestic purposes the gas for lighting and for fuel passes through the same meter; the Statistical Department of the Association hope, however, to obtain more definite figures during the present year.

The following figures show how all the gas sold for fuel and lighting by the companies reporting and the diagrams are made out from these.

Year	Cubic Feet Sold.
1900	67,093,553,000
1905	117,866,000,000
1908	156,909,310,000
1912	212,391,168,000

These figures are split up into oil and water-gas and coal-gas, in the tabulations which follow. In the reports on the production of gas for the years prior to 1905 the statistics were limited to the operations of coal gas works and retort ovens, the statistics of water gas production being compiled (by the United States Geological Survey) for the first time in 1905. The first year for which the statistics of the production of oil gas were collected was 1907, and they are included with the production of water gas in 1907, 1908 and 1912.

The following shows these quantities of the gas produced at coal gas works and by-product coke ovens in the United States.

Year	Quantity in M. Cu. Ft.
1903	31,049,462
1904	34,814,991
1905	40,454,215
1907	54,819,685
1908	53,561,811
1912	89,693,372

The following table shows the relative gains by coal, and water and oil gas respectively, and as a total, the figures being derived as previously indicated.

Year.	Quantity of Coal Gas.	Total Per Cent.	Quantity of Water Gas	Total Per Cent.
1905	40,454,000,000	34.3	77,412,000,000	65.7
1908	53,561,813,000	34.1	103,347,397,000	65.9
1912	89,693,372,000	42.2	122,697,796,000	57.8

Fig. 4 shows these changes graphically.

It is most important to note that coal gas and coke oven gas have not been separated in Mr. Parker's report, and this should be borne in mind when following out the figures he shows. The figures given include coke oven gas sold to gas companies at a very low price. This, it should be remembered, has to be enriched and treated before it can be sold to consumers. Therefore, the average prices given cannot be taken as the actual average *retail* prices of the gas. General interest is being taken at this time in the rapid rise in favor of gas company bonds and stocks. The reasons for this are based upon three fundamental factions (1) Security, (2) Business Expansion, (3) Advanced Commercial Practice. All these points are fully recognized by the financial authorities.

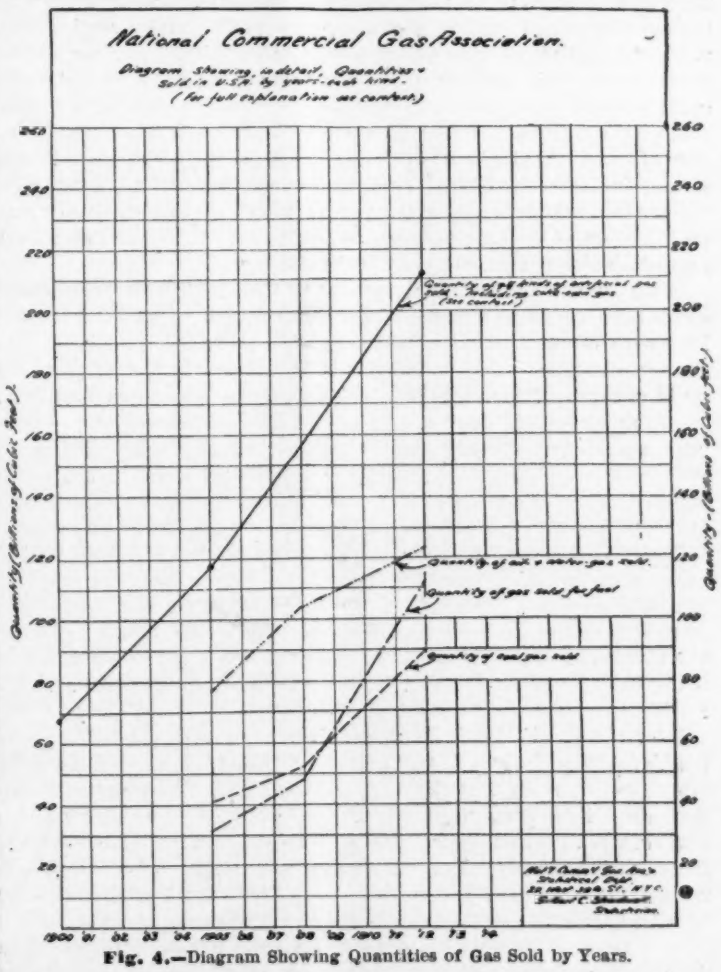
National Commercial Gas Association.
Diagram Showing, in detail, Quantities of Gas Sold in U.S.A. by years - each kind. (For full explanation see context)
Quantity of all kinds of artificial gas sold; including coke oven gas (see context)
Quantity of oil & water gas sold.
Quantity of gas sold for fuel
Quantity of coal gas sold
Quantity - (Billions of Cubic Feet)
1900 01 02 03 04 1905 06 07 08 09 1910 11 12 13 14

Fig. 4.—Diagram Showing Quantities of Gas Sold by Years.

Mr. Lansley quotes from Mr. Lawrence MacIntyre as follows:

"Gas Bonds merit the very highest degree of confidence. While it has been impossible to get the exact figures, there is in the neighborhood of $400,000,000 invested in the mortgage debts (or their equivalent) of gas companies in the United States, and of this enormous amount there is probably less than 1 per cent. of the interest in default, a record not equalled by any form of investment other than United States Government bonds."

A gas company's plant is something entirely tangible. These points show the importance and strength of the gas industry, and its continued advance is a matter of which there can be no doubt.

Recent Improvements in Gas Manufacture.[1]

[From a paper by ALFRED E. FORSTALL.]

The process of manufacturing illuminating gas divides itself into two stages, the generation of crude gas from the raw materials, and the purification of this crude gas to make it fit for general use.

Taking up first the generation of coal gas, an important recent improvement is the development and quite general installation of retorts set vertically, which was unsuccessfully tried in the early years of the nineteenth century. Retorts set horizontally have been used solely, until, in 1885, M. Andre Coze developed a setting in which the retorts were inclined at an angle of from 29° to 33° to the horizontal. At such angles the coal would spread fairly evenly over the whole length of the retort by gravitation and the coke would run out fairly easily when the charges were thoroughly carbonized. Though adopted quite generally abroad only three important installations of inclined retorts, and not more than five or six minor ones, were made in the United States.

In the year 1902 two types of vertical retort settings, the intermittent and the continuous, were brought to the attention of gas men. The intermittent type, in which a quantity of coal which nearly or entirely fills the retort is put in at one time and allowed to remain until the whole is carbonized when the resulting coke is dropped out, also at one operation, was developed by Dr. Bueb in the gas works at Dessau, Germany. The first patent taken out on these retorts, in

1, Read before the New York Section of the Society of Chemical Industry.

1902, described them as provided with outlets, spaced from top to bottom along the length of the retort and opening into a vertical flue so placed in the setting as not be exposed to a high heat, the object being to permit the gas driven out of the coal to escape to the hydraulic main without being subjected to contact with either the highly heated coke or the walls of the retort. Settings built under this patent were put into operation in 1903 but the side outlets were abandoned soon after actual operation began, and by 1905 the design had been developed to that which is now employed, in which the gas evolved from each portion of the charge travels through all the superincumbent portion, before it escapes to the hydraulic main.

In the Dessau verticals as developed in Europe the retorts are made either four meters or five meters (13 feet 2 inches or 16 feet 5 inches) long with cross-sectional dimensions of approximately 9 inches by 22 inches at the top and 14 inches by 27 inches at the bottom; and are set in groups of 12 or 18, each group heated by its own gas producer, or generator furnace, and provided with its own recuperators. In the only installation of this type in the United States (Providence, R. I.) the retorts are 13 feet 2 inches long with the cross-section given above and are set ten in a bench. The coal is charged into the retorts from overhead bunkers and the coke is dropped into buggies or a conveyor.

The combustion of the producer gas takes place in a combustion chamber surrounding the lower ends of the retorts; and the products of combustion pass horizontally to the back of the setting and then up to a second set of horizontal flues running to the front, up again to a third set running to the back and then into a fourth set running to the front and pass out from top of the bench to the recuperators and thence to the chimney.

Intermittent Vertical Retorts—U. G. I. Company.—In Am rica the United Gas Improvement Company began experimenting with intermittently filled vertical retorts about 1908. The benches of this type last built contain nine retorts each 18 feet 6 inches long with an oval section 12 inches by 22 inches at the top and 18 inches by 30 inches at the bottom. The reasons for the larger cross section are that when smaller the coal coked too rapidly at the top of the retort causing excessive pressure at the bottom, that with the small retort the discharge of the coke did not take place satisfactorily except when the whole charge of coal was thoroughly carbonized, while a large retort will discharge readily even when the coal has not been thoroughly carbon zed, and that the larger retorts produce larger coke, an advantage in many localities. In this setting the production of the producer gas also takes place around the lower ends of the retorts and the products of combustion pass upward to the top of the setting.

The German practice is to fill the retorts completely with coal while the United Gas Improvement Company leave 4 feet of the retort at the top empty, to provide a space in which the heavy hydrocarbon vapors may be converted into gas by the action of radiant heat.

It is interesting to note that in 1880 Mr. C. F. Dietrich obtained a United States patent making claims for a setting of retorts which were very similar to those of the original Bueb patent, including even the lateral openings into a channel protected from heat through which the gas could pass from the retort. At that time, however, conditions in this country were favorable to the manufacture of carbureted water gas and the field for coal gas did not seem to warrant the trouble of developing a new method of manufacture, so that apart from building one experimental bench nothing was done to develop these retorts.

Passage of Gas Through Intermittent Retorts.—The reason for the side outlets in the retorts under the original Bueb patent was the belief that, if compelled to pass up through the incandescent charge, the hydrocarbons first evolved from the coal would be decomposed into hydrocarbons of lesser illuminating and calorific value; and that carbon and naphthalene would be formed and cause trouble in handling the gas as it passed from the generating apparatus to the consumer. The disadvantage of the side outlets was that the retort could not be heated around its entire perimeter and that, therefore, more fuel was required for the carbonization of a given weight of coal. When the lateral outlets were bricked up and the gas taken off at the top of the retort the decomposition of the hydrocarbons was not as great as had been anticipated, provided the retorts were heated to a very high temperature and care taken to completely fill them with coal. It was claimed that under these conditions the generation of the gas from the portions of the coal was at once converted into a compact coke, impermeable to the gas generated. The gas was therefore forced to pass, from all points of the layer in which carbonization was taking place inward and upward through the uncoked and more permeable central portions of the charge. Its temperature was thus prevented from rising to the point at which over-decomposition of the heavy hydrocarbons, with the formation of carbon and naphthalene would take place.

This theory as to the course taken by the gas in passing through the charge in an intermittently charged vertical retort was for a long time accepted as correct, but recently Dr. H. L. Colman, in England, and Mr. O. B. Evans, in the United States, have reached the conclusion, as the result of experiments, that in reality only part of the gas travels through the core of uncarbonized coal and the rest travels through the incandescent coke. Dr. Colman argues that if even the largest portion of it traveled through the uncarbonized coal, the gas would show some of the characteristics of a gas produced at a low temperature, modified to some extent by the gas produced in the latter stages as the temperature of the coke is raised, and that the tar produced would be a low temperature tar containing but a small amount of aromatic substances. As a matter of fact his analyses show that the gas possessed all the characteristics arising from exposure to high temperatures, the proportion of hydrogen to methane being even higher than that obtained from the same coal distilled in highly heated horizontal retorts, and the tar produced, although containing more parffin derivatives than tar from horizontal retorts, consisted chiefly of aromatic substances, showing that, during its formation, the vapors produced at low temperatures must have been subjected to a considerably higher temperature before passing out of the retort. This could not happen if even the larger part of the vapors passed through the uncarbonized coal, since the travel would be in a direction that would expose them to a constantly decreasing, instead of a higher temperature. Moreover, the existence of a high pressure in the retort at the commencement of carbonization when the area of the core was greatest, and the diminishing of this pressure as carbonization proceeded, although the rate at which gas was produced did not decrease greatly during the first seven hours, while the area of the core did decrease quite rapidly, was strong evidence that the gas did not find its principal exit through the core. He concludes that the great bulk of the gas is produced on the outer side of the pasty layer formed by the coal as it carbonizes, and that the gas travels mainly through the hot coke, mixing with the poorer gas produced by the continued action of heat on the low-temperature coke first made. The gas produced in the inner side of the pasty layer will pass through the coal and he considers it probable that the vapors which pass in this direction form the undesirable paraffin constituents of the tar so that as far as travel through the core does take place it is disadvantageous.

Mr. Evans, reasoning from the pressure conditions existing in the interior of an intermittently charged vertical retort, came to the conclusion that during the early part of the charge, when the layer of coke formed around the perimeter of the retort was compact and offered no ready means of passage to the gas, most of the gas produced was obliged to force its way through the pasty layer of coal in the initial stage of carbonization, and pass up through the uncarbonized coal, but that as the outer layer of coke contracted and cracked under further heating most of the gas formed in the latter portions of the charge passed up through this coke. He also concluded that of the gas made during the first 6 hours which amounted to 70 per cent. of the total made, 45 per cent. passed up inside of the pasty layer through the core, and 55 per cent. through the hot coke next to the retort walls, and that the gas evolved at low temperatures escapes through the core while that evolved at high temperatures escapes along the wall. Mr. Evans considers that this is advantageous since the low temperature gas is more subject to injury by exposure to heat, and this is correct provided that after leaving the coal this gas is exposed to heat in a free space at the top of the retort. This discussion as to the path followed by the gas in passing out from intermittently charged vertical retorts has been given somewhat at length because of the claims originally made that the freedom from naphthaline experienced with gas made in such retorts was largely due to the fact that the travel was through the cool core of uncarbonized coal.

English Development of Continuous Vertical Retorts.—While the work of the Germans with vertical retorts was confined to those charged intermittently, in England the design was approached with the idea of adapting them to continuous carbonization. This had been tried with horizontal retorts and had given good results as far as the quantity and quality of the gas were concerned but had failed because of mechanical troubles. In 1902 a setting of vertical retorts was built at Exeter, into which the coal, in amounts varying from 2

pounds to 7 pounds was charged at regular intervals, the length of which could be varied. The retorts, about 9 feet long, were made straight for part of the distance and then were curved so that the coke was withdrawn through an opening in the side of the setting. The coke was drawn intermittently in comparatively large quantities at a time so that the extent to which the retort was filled with coke and coal varied considerably. After being tried in other places in England, further use of the settings was abandoned because of trouble with the coal-feeding device and in keeping the curved portion of the retort from cracking, and also with the formation of lampblack owing to the large variation in the volume of the charge because of the intermittent drawing of the coke and the consequent variation in the extent to which the gas passing off from the charge was exposed to heat in the vacant space at the top of the retort.

Woodall-Duckham Vertical Retorts.—While this retort was being experimented with Messrs. Woodall and Duckham were developing at Bournemouth, another type of continuously charged verticals, starting with a mechanical coal feed and mechanical continuous extraction of the coke. The first was soon abandoned because of operating difficulties and the introduction of coal into the retort is now brought about entirely as a result of the extraction of coke from the bottom. As now built each retort is surmounted by a charging magazine filled through a rotary valve from an overhead coal bunker and holding enough coal for 2 hours' supply. There is free communication between the magazine and the top of the retort, the coal in the former being supported by that in the retort. As the extractor withdraws the coke from the bottom the whole column of material in the retort settles and coal runs in at the top from the magazine, which is replenished with coal at intervals of from 20 minutes to an hour.

The coke extracting device consists of a rotating horizontal shaft provided with arms placed spirally around it, and of loose arms hung on hinges at their upper end and having sufficient weight to hold back the coke except as their lower ends are pushed out by the action of the revolving shaft. The coke is discharged into a closed hopper which will hold the amount produced during 2 hours, and is intermittently emptied either into dumping wagons or into a conveyor. The extractor can be run at varying speeds to suit the quantity of coal that can be carbonized under varying conditions.

As originally built the settings consisted of four oval retorts 25 feet long and having cross-sectional dimensions of practically 9 inches by 23 inches at the top and 20 inches by 29 inches at the bottom. In recent installations the retorts have been replaced by rectangular ovens, or slots, of the same length and having cross-sectional dimensions of 8 inches by 3 feet 10 inches at the top and 20 inches by 5 feet 3 inches at the bottom. At the top of these slots there is a division plate, extending down an adjustable distance, forming two separate spaces, into one of which the coal magazine opens while the other is kept free from coal so that the gas can pass out through it and in passing out be exposed to radiant heat for the purpose of decomposing the hydrocarbon vapors with low boiling points. As the settings are operated it would seem that the desired effect is obtained to only a very limited extent, if at all. The combustion of the producer gas begins at the top of the setting and the products of combustion pass down, surrounding the retorts and are taken off into the recuperators a short distance above the bottom. From the recuperators they pass either directly to the chimney or in some cases through a waste heat boiler which furnishes the steam required for the operation of the plant. The primary air is heated before entering the furnace by passing across the setting in contact with the side walls of the retorts at their lower end, and the coke is sufficiently cooled in this way to require no quenching.

Glover-West Vertical Retorts.—During this time Messrs. Young and Glover at St. Helens were working what is now known as the Glover-West system of continuous vertical retorts. The chief differences between the Woodall-Duckham and the Glover-West systems are in the form of the coke extractor and in the methods of heating the retorts. In both, the coal runs into the retorts from a charging magazine as the coke is extracted at the bottom. The coke extractor with Glover-West is a worm with its axis vertical which slowly revolves and delivers coke into a receiving chamber, large enough to hold that produced during 2 hours and regularly discharged at any interval of less than 2 hours. The retorts are oval in section and have a total length of 20 feet with cross-sectional dimensions of 10 inches by 30 inches at the top and 22 inches by 36 inches at the bottom. To the bottom of each one is added a cast iron chamber 3 feet deep, at the bottom of which is placed the coke extractor. The retorts are set in groups of eight, and the setting divided into either two or four chambers so that the retorts can be worked in units of four or two. The combustion of the producer gas takes place at six points evenly spaced along the portion of each chamber extending from the bottom to within about 5 feet of the top, and the products of combustion, after passing horizontally around each set of retorts, ascend through vertical flues to chambers surrounding the upper 5 feet of the retorts, from which they pass to the chimney. The secondary air is heated by passing the cast iron chambers at the lower end of the retorts and this cools the hot coke on its way to the coke extractors, and does away with the necessity of quenching it when taken from the coke chambers.

Operation of Horizontal Retorts Modified.—Partly as a consequence of, the successful introduction of intermittently charged vertical retorts the method of operating horizontal retorts has been substantially modified. This had been to charge such retorts with a layer of coal about 4 inches to 5 inches thick leaving a large free space above the coal, through which the gas passes to the mouthpiece and standpipe. The maximum charge for a 9 foot retort with one end permanently closed, in general use in the United States, was from 310 to 350 pounds of coal. The front end of the retort being enclosed in the wall of the bench for a depth of 13 inches, a foot of the length was not effective for carbonizing purposes and the weight of charge was not more than 45 pounds, and in many cases 40 pounds per lineal foot of the effective portion. There had been some theoretical discussion of the advisability of more completely filling the retorts, but this had not produced any result in practice until the completely filled vertical retorts afforded an object lesson of the freedom from carbon and naphthalene troubles secured by reducing the contact of the gas with the highly heated walls of a retort. In England, where the use of retorts open at both ends was common, it was easy to change from lighter charges to heavier ones, but in the United States it was necessary to change to through retorts instead of single end ones before the increase in weight of charge could be made, since where the coke is drawn from the retort by a rake it is necessary to leave sufficient space above the charge to permit the free passage of the rake; while from through retorts the coke can be pushed and provision for the passage of the rake does not have to be made. The present practice, with through retorts is to charge about 70 pounds of coal per lineal foot of the effective portion of the retort. When so charged from 60 per cent. to 70 per cent. of the area of the retort is occupied by coal leaving only 30 per cent. to 34 per cent. of the area for the passage of the gas; while a 40 pound to 45 pound charge only occupies from 30 per cent. to 36 per cent. of the area. The expansion of the charge during the coking process makes the actual free space left in the retort still smaller in proportion for the heavy charges. The use of heavier charges has resulted in a large increase in gas made per pound of coal, with a decrease of those operating difficulties caused by free carbon in the gas and in the tar. In England the yield of gas formerly averaging about 10,500 cubic feet per ton of 2,240 pounds of coal now averages nearly 12,000 cubic feet; while at Worcester, Mass., the former average yield of 5 cubic feet per pound has been increased to 5.9 cubic feet. Other works in the United States which have adopted heavy charges have increased the yields of gas about 10 per cent. without any decrease in illuminating value or calorific value per cubic foot; therefore obtaining greater total illuminating value and calorific value in the gas from a given quantity of coal.

The yield from continuous vertical retorts is also greater than that formerly obtained from horizontal retorts operated with light charges, but in this country is not as large as that obtained from the horizontal retorts at Worcester, Mass.

Comparison of Gases from Horizontal and Vertical Retorts.—These analyses are of the gas made in two plants, one having horizontal retorts and the other vertical retorts of the Woodall-Duckham type. The horizontal retorts are operated with moderately heavy charges, not however, up to 70 pounds per lineal foot of retort. These plants are under one management, and the coal is purchased from one company and is presumably the same, so that the analyses show, to some extent, the differences due to the methods of carbonization. The total illuminants run slightly higher, and there is much less hydrogen in proportion to the methane, in the gas from the vertical retorts. The illuminating value of the gas from the verticals is higher, while the yield per pound of coal is 10 per cent. greater. In the horizontal retorts very wet coal was being carbonized and this may have affected the illuminating value and the yield of gas which were lower during this period than the average for the preceding

month; but even the averages for that month were lower than the results obtained from the vertical retorts which were those made during a test lasting 8 days, and in regular working the results have not been quite as good.

	Horizontal Retorts, Per Cent.	Vertical Retorts, Per Cent.
Carbon dioxide	1.44	1.49
Benzol	0.67	0.55
Illuminants	3.15	3.98
Oxygen	0.48	0.28
Carbon monoxide	4.75	6.90
Hydrogen	51.36	45.02
Methane	33.60	37.33
Nitrogen	4.55	4.44
	100.00	99.99
Candle power (Sugg D burner)	13.60	15.57
Calorific value (B.T.U. per cubic feet by calculation)	610.00	....
Calorific value (B.T.U. per cubic feet observed)	....	615.00
Yield, cubic feet per pound of coal	4.85	5.39

Comparable analyses of the gas made in the working scale testing plant at the gas works in Birmingham, England, in intermittent vertical retorts, of the Dessau type apparently charged so as to leave a free space above the coal at the top of the retort; and in horizontal retorts are given by Dr. W. B. Davidson, as follows:

	Dessau Verticals, Per Cent.	Horizontals, Per Cent.
CO_2	2.4	2.2
C_nH_m	2.8	3.4
O_2	0.5	0.5
CO	10.3	9.7
CH_4	28.0	31.5
H_2	51·0	47.3
N_2	5.0	5.4
	100.0	100.0
Illuminating value, candles	15.0	18.0
Net calorific B.T.U. per cubic feet	500.0	525.0

Note.—The illuminating values given by Dr. Davidson cannot be compared directly with those given previously since they were obtained on the Metropolitan No. 2 Argand burner and are probably about three candles higher than would have been obtained with the Sugg D Argand used in the other case.

Dr. Davidson observes that the gas made in the vertical retort is deficient in unsaturated hydrocarbons and methane, and high in hydrogen, and that a cursory examination of the analyses leads to the conclusion that the hydrocarbon gases are subject to more drastic degradation before leaving the retort in the vertical system than they are in the horizontal system, but that it is not unlikely that the gas suffers both in quality and volume by the escape uncracked of a larger proportion than usual of tar oil vapors. Experience with the United Gas Improvement Company verticals operated with a large free space above the coal seems to show that this space leads to an improvement in the illuminating and calorific value of the gas, which is obtained at the expense of the extra quantity of tar produced when the retorts are completely filled.

In quality and quantity of gas intermittent vertical retorts of the Dessau system give poorer results than are obtained in horizontal retorts, while the intermittent verticals of the United Gas Improvement Company type, and continuous verticals do not give any better results than can be obtained from properly operated horizontal retorts. The improvements effected by vertical retorts consist in a saving of labor in medium-sized plants in which it is impossible to work charging and discharging machinery for horizontal retorts to advantage, and in greater freedom from trouble by free carbon and naphthalene; while the sulphur compounds other than sulphureted hydrogen are also produced in smaller amount. In addition there is a saving in ground space required, although it is necessary to go higher into the air with verticals. To these advantages the continuous vertical retort system adds that of practically complete avoidance of the smoke and steam emitted during the charging and discharging of horizontal retorts and intermittent vertical ones.

Suggested Method of Distillation.—The character of the products given off by coal subjected to distillation at different temperatures indicates that the greatest gas making efficiency, would be obtained by so adjusting the heating of continuous vertical retorts that the temperature of the upper 2 or 3 ft. of the charge would never exceed 1000° to 1100° F., while the lower portion of the charge was carried as high as 1800° F. By this method of heating, the rich hydrocarbons would be driven off without having to come into contact with very highly heated surfaces, while the remaining gas which is of such a character as not to suffer to any great extent from such contact, would be expelled from the coal when in the lower portion of the retort.

To decompose the heavy hydrocarbon vapors, (which would otherwise condense into tar) and to convert them into the maximum amount of permanent gas mixed with hydrocarbon vapors that could be carried by the gas, all of the gas leaving the top of the charge should be passed through a free space exposed to heat radiated from walls at a temperature adjusted to the rate of travel of the gas, but probably about 1400° to 1500° F. This space could be maintained either in the upper part of the retort or, if this leads to difficulty in feeding the coal, it might be entirely separate from the retort and possibly common to several retorts. This method of manufacture would increase the quantity and quality of the gas at the expense of the tar, and would not be advantageous unless the value of the gas gained was greater than that of the tar lost. It has never been actually worked but in my opinion is entirely feasible.

Improvements in Manufacture of Carbureted Water Gas.—Recent improvements in the manufacture of carbureted water gas consist in the general use, of appliances for measuring the air blown through the fuel bed during the "blow," and the steam passed through the fire during the "run," and the use of the electric pyrometers for indicating the temperatures existing at selected points in the checker brick of the carbureter and superheater. These appliances make it possible to constantly operate the apparatus under those conditions of blast, steam and temperature that will give the best results; and by so doing decrease the fuel used and increase the efficiency of the conversion of the oil into oil gas.

Preparation of Crude Gas for Delivery to Consumer.—In the second division of the process of gas manufacture, that of the preparation of the crude gas for delivery to the consumer, the recent improvements have been chiefly in connection with the removal of hydrogen sulphide and the other sulphur compounds present in the crude gas. For many years attempts have been made to use the ammonia obtained from the gas for the removal of hydrogen sulphide from coal gas. About 1886 a process for doing this was devised by Claus in Belfast, Ireland. Although chemically correct it proved too complicated mechanically and was finally abandoned. It is possible that if modern centrifugal pumps had been available the process might have been successfully operated. In the United States an extremely simply method has been recently devised by Mr. Jas. G. O'Neill and used on coke oven gas sold for illuminating.

The ammonia in ordinary ammoniacal liquor is already largely saturated with sulphur and carbon dioxide and one of the chief problems in connection with the use of this liquor for more complete removal of sulphureted hydrogen is to accomplish its conversion into a condition suitable for combination with sulphureted hydrogen without introducing too much complication of apparatus. Mr. O'Neill has solved this problem by using liquor withdrawn from a still of the Coffey type, which is in general use for the concentration of ammoniacal liquor. He finds that when the liquor fed to the still has reached the point at which it has a temperature of 214° to 215° F. it has lost 80 to 90 per cent of the hydrogen sulphide, and 70 to 80 per cent of the carbon dioxide, but still retains practically all the ammonia it contained when it entered the still. When brought in contact with crude coal gas in scrubbers of the ordinary type, this liquor will take up on an average 500 grains of hydrogen sulphide per gallon and if used in sufficient quantities will reduce it from as much as 900 grains, down to from 20 to 30 grains, per cubic feet of gas. If the complete removal of the hydrogen sulphide with liquor is attempted the efficiency of the liquor is much less than this and it is much more economical to use the liquor only to the extent named and then finish the removal by hydrated sesquioxide of iron.

Mr. O'Neill's process adds to the apparatus customarily found in gas works only a heat exchanger, in which heat is transferred from the hot liquor coming from the concentrating still to the cool liquor on its way to the still; and a cooler for further cooling the treated liquor; both of which are inexpensive. Apparently this process could be adopted in many coal gas works with a saving in labor required to operate the oxide of iron purifiers, and in the investment in the purifiers required for a given quantity of gas.

Removal of Other Sulphur Compounds.—In Europe, where the gas coals contain as a rule more sulphur than those in common use in the United States, and on the Pacific Coast, where gas is largely made from crude petroleum containing a high percentage of sulphur, the problem of reducing the sulphur compounds, other than hydrogen sulphide in crude illuminating gas has had some importance. Therefore, attention has recently been paid to new methods of removing the principal one of these sulphur compounds, carbon bisulphide. Of the recent processes, the one first brought to the attention of gas engineers was that devised by Messrs. Hall and Papst and used since 1908 for the treatment of all the gas made (about 3,000,000 cubic feet per day) at Portland, Oregon. In this process the gas is heated to from 1300° to 1600° F. by being passed through tall cylindrical vessels filled with checker work of fire bick, which are heated by the combustion in them of fuel oil. The vessels are in pairs, one being in process of heating while gas is being passed through the other. The operations are reversed as soon as the vessel through which the gas is passing becomes cooled below the effective temperature. Under the effect of heat the carbon bisulphide reacts with the water vapor present in the gas and is largely converted into hydrogen sulphide, which is removed by purifiers containing oxide of iron.

Nickel Catalyzer for Decomposition of Carbon Bisuphide.—Another process employed on a large scale is that devised by Mr. E. V. Evans and used to treat the gas made (about 10,000,000 cubic feet per day) at the works of the South Metropolitan Gas Company, London. This process utilizes the catalytic effect of nickel in accelerating the reaction between carbon bisulphide and steam, by which hydrogen sulphide is produced and carbon set free. The catalyzer is in the form of balls of fire clay, one inch in diamater impregnated with nickel obtained by the reduction of the chloride in a current of hydrogen. These balls are contained in tubes 11.5 feet long, and six inch diameter, through which the gas is passed. Before reaching the catalyzing tubes the gas passes through heat exchangers, or recuperators, in which it absorbs heat from the gas passing out from the apparatus, and then through preheating tubes in which its temperature is raised to 750° F. With this preheating of the gas it is possible to carry on the process at a temperature of 800° F. in the catalyzing tubes. A single combustion chamber, supplied with producer gas from an outside producer, furnishes the heat for both the preheating and the catalyzing tubes. After about thirty days' use it is necessary to stop the flow of gas through a set of catalysers and blow air through them to burn off the deposited carbon which is found to be, at times, 50 per cent in excess of the quantity calculated from the amount of carbon bisulphide reduced to hydrogen sulphide. This carbon may come from the decomposition of hydrocarbons in gas, but analyses of the gas before and after treatment, which are given below, show that the quantity so decomposed is negligible.

	Gas Before Treatment Per Cent.	Gas After Treatment Per Cent.
Co_2	1.82	1.80
C_nH_m	3.61	3.79
O_2	0.27	0.07
CO	8.85	8.62
CH_4	26.62	27.45
H_2	52.45	52.19
N_2 (by difference)	6.38	6.38
	100.00	100.00
Illuminating power in English candles	14.05	14.05
Calorific value, B. T. U. per cubic feet	590.00	594·00

Soda-Cellulose for Removal of Carbon Bisulphide..—Another process tried at an experimental plant of the Heidelberg, Germany, Gas Works consists in treating the gas, entirely freed from tar, ammonia, sulphureted hydrogen and carbon dioxide, with a componnd of soda and cellulose obtained by treating cellulose sulphite with soda lye. The resulting material rolled and crumbled to a powder, is placed on trays in purifying vessels in the same way as oxide of iron. When brought into contact with carbon bisulphide the soda cellulose is changed into cellulose xanthogenate or viscose, the raw material from which are obtained cellulose hydrate and the formyl-cellulose used in the manufacture of non-inflammable celluloid. In the experimental plant ten tons of the soda cellulose material, known as "Athion," absorbed 1.25 tons of carbon bisulphide so that with gas containing 45 grains per 100 cubic feet, ten tons would purify over 35,000,000 cubic feet of gas, but the cost of operation is not given. Since it is not the custom in the United States to remove carbon dioxide from illuminating gas, the employment of this process would involve the installation of additional apparatus for that purpose.

Oxide of Iron Catalyzer for Decomposition of Carbon Bisulphide.—A very promising process, not yet tried on a working scale, is based upon the fact that at temperatures above 100° F. metallic iron acts as a catalyzer in the reaction between bisulphide of carbon and moisture in illuminating gas. The fact that gas, free from sulphureted hydrogen contained this substance after having passed through a wrought iron service pipe running near a steam pipe, attracted the attention of Mr. J. G. Taplay and experiments made by him showed that a temperature of 158° F. the reaction between the bisulphide of carbon and moisture with the formation of sulphureted hydrogen took place quite rapidly, in gas traveling through a wrought iron pipe, and also that as the interior of the pipe became rusted the sulphureted hydrogen produced was absorbed by the oxide of iron and did not show at the outlet of the pipe. A French gas engineer, M. Guillet, observed the same action taking place inside a gas holder and by experiments determined that when gas containing bisulphide of carbon was passed through ordinary oxide of iron purifying material at temperatures above 25° C (72° F.) 25 per cent. of the original content of carbon bisulfide was removed. He found 100° C. (212° F.) to be the temperature at which the change became interestingly rapid, while at a temperature of 130° C. (266° F) more than 67 per cent. of the bisulphide originally present was converted into hydrogen sulphide and removed. The percentage removed increased with the amount original present, the treated gas containing only from 3.01 to 5.82 grains, while the original gas contained from 9.48 to 24.42 grains of bisulphide per 100 cubic feet.

Since the efficiency of oxide of iron for the removal of sulphureted hydrogen is very much increased by heating and it should not be difficult to maintain the temperature of the purifying material at the comparatively low temperature of, say, 250° F. this process would seem to offer the simplest and most inexpensive means of removing from illuminating gas the larger part of the bisulphide of carbon which it contains after the treatment ordinarily given to it in gas works, whenever the amount of this impurity present is sufficiently large to make it important that it should be reduced.

Report of the Ventilation Research Committee, Institution of Gas Engineers (England).[1]

In 1913, the Council of the Institution considered the advisability of promoting an investigation of the ventilation problem, and a committee was appointed, representing the Institution and the University of Leeds, to deliberate upon the subject.

After full discussion, the Committee reported unanimously in favor of the project; and they were thereupon authorized to take the neccessary steps to carry their recommendation into effect.

The Committee made their recommendation, and have entered upon their work with a full sense of the difficulties involved. Ventilation has been the subject of innumerable investigations, resulting in the accumulation of much knowledge. Notwithstanding the vital importance of the question, however, from the standpoint of public health, and the constant and urgent demand for reliable information, it must be confessed that the whole subject is in a fluid state, and that great differences of opinion and practice prevail. Data which could serve as a safe basis for dealing in a scientific way with the problems of ventilation as they arise in their endless variations are largely wanting.

This unsatisfactory state of things arises, no doubt, in the main from the inherent difficulties of the subject. The extreme mobility of air, its susceptibility to slight changes of temperature and pressure, the difficulties of discerning, tracing, and measuring currents of air, are too well known to need emphasizing; and the great differences in the conditions in different cases enable us to understand that no series of simple prescriptions of universal applicability can be evolved.

Notwithstanding their full appreciation of these difficulties, the Committee felt that the importance of the subject must compel them to proceed if they could see any field for inquiry, however limited, that appeared to give reasonable promise of affording useful knowledge. After consideration, they decided that it would be well worth

1. Slightly abridged.—Eds.

(*Continued on page 74.*)

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NOTICE TO ADVERTISERS.

New Advertisements and changes of copy therefor should be in hand Wednesday noon of week prior to date of issue.

NEW YORK, MONDAY, AUGUST 3, 1914.

[Official Notice.]

New Jersey State Gas Association.

Office of the Secretary,
Broad and Bank streets, Newark, N. J.,
July 21, 1914.

The next meeting of the New Jersey State Gas Association will be held at Wardell's, Port-au-Peck, on Pleasure Bay, Wednesday, Aug. 12, 1914. The meeting will convene at 10 A.M., and the following papers will be read and discussed:

"Development and Possibilities of Gas Water Heating," by Mr. Herbert Long, of Long-Landreth Company, New Brunswick, N. J.

"Newest Things in Gas Lighting," by Mr. F. N. Hamerstrom, of the Welsbach Company, Gloucester, N. J., and Mr. J. P. Conroy, of the General Gas Light Company, New York city.

"Auxiliary Heating," by Mr. William Schofield, of the Sanitary Heating Company, Brooklyn, N. Y.

The session will continue until 2 P.M., at which time a clam bake will be served. This "Bake" is an annual event of the New Jersey State Gas Association, and the chef preparing it is famous throughout this part of the country.

Is is expected that every member of the Association will be present and that many guests will also enjoy the hospitality of the Association.

Wardell's can be reached via. P. R. R. or C. R. R. of N. J., to Long Branch, thence by trolley to Pleasure Bay.

O. F. Potter, Secy.

[Official Notice.]

Michigan Gas Association Meeting.

Office of the Secretary-Treasurer,
Grand Rapids, Mich., June 29, 1914.

The annual meeting of the Michigan Gas Association will be held at Lake Harbor, Wednesday, Thursday and Friday, September 2, 3 and 4. This decision has just been made by the Executive Committee of the Association and we are sure those attending the meeting will find this departure from the regular practice of holding gas association meetings in the large cities, a most delightful experience.

Lake Harbor is a resort beautifully located on Lake Michigan and an inland lake 4 miles south of Muskegon, Mich. It is reached by Goodrich Boat Line via Muskegon, and by the Grand Rapids and Indiana Railway, and the Grand Rapids-Muskegon Electric Road via Grand Rapids. The hotel accommodates 500 guests, is prettily located and gives excellent service. There is a fine 18 hole golf course, baseball grounds, 9 tennis courts, Lake Michigan bathing beach, fine bath houses, bowling alley, billiards, canoeing and good automobile roads. There is a combination theater and convention hall which may be used for dancing parties as well as for the business sessions of the convention.

There are a number of cottages in connection with the hotel, and it is hoped that members will bring their wives and children, for the resort specially caters to the whole family.

At the time chosen, the association will have the resort practically to itself, and there is enough to do aside from a carefully planned business programme, which will be announced later, to make the trip worth while to any gas man within reachable distance of Michigan. Every gas man is invited to meet with us whether a member of the association or not. The hotel rates are on the American plan ranging from $3 a day without bath, to $4 and $5 a day with bath; and will for this occasion cover the use of the golf course, tennis courts and other features for which there is usually an additional charge. Glenn R. Chamberlain, Secy. Treas.

[Official Notice.]

Illuminating Engineering Society.

Mr. A. G. Summerell, Chairman of the Hotel Committtee for the Eighth Annual Convention of the I. E. S., to be held at Cleveland, September 21st to 25th, inclusive, gives the following information:

The Hollenden Hotel, Convention headquarters, is located at East 6th street and Superior avenue, right in the heart of the city. Cars leaving the Union Depot stop directly in front of the hotel. Besides the depot cars, the Superior line, which goes to Rockefeller Park and East Boulevard, the Payne avenue line, to Wade and Rockefeller Parks, and the Scovill line to Luna Park pass the door. The Euclid car, the main artery of the east end, is but a block from the hotel. Practically every car line in the city, except the cross town lines, is within two minutes walk.

The Hollenden Hotel is an ideal one for convention purposes, because of the immense amount of ground floor space, covering something like 40,000 square feet, all devoted to guests, and it is possible to reach the elevator and any part of the hotel without passing through the lobby. Without leaving the hotel, guests may dine in almost any style or atmosphere. There are four separate places to dine, the Crystal Room, the Grill Room, the Porch Restaurant and the Men's Cafe; all on the lower floor, except the Porch Restaurant, which is located on the marquee over the Superior avenue entrance, and is operated whenever weather permits. In the Crystal Room club breakfasts are served for from 50 cents to $1; at noon a club lunch is served in the Grill for from 50 cents to 80 cents, and a club supper for from 50 cents to $1.25.

There are 750 guest rooms with rates as follows:

Single rooms with bath.....	$2.00;	$2.50;	$3.00;	$3.50.
Double " "	3.00;	3.50;	4.00;	5.00.
Twin-bed rooms "	4.00;	5.00;	6.00.	

Those desiring reservations should write directly to the Hotel, giving the price of room they wish and as nearly as possible their time of arrival.

Most, if not all, of the conventions business sessions will be in the Hotel, and the Annual Reception-Ball and Banquet will probably be held there as well.

BRIEFLY TOLD.

Trade Unions and Public Utilities.—Democracy in industry was the common factor in a wide divergence of views gathered by the United States commission on Industrial Relations at a recent hearing in Chicago. John Fitzpatrick, head of the Chicago Federation of Labor, and John M. Glenn, secretary of the Illinois Manufacturers' Association, displayed the radical attitudes of labor and capital. Middle ground was taken by four others including Mr. Samuel Insull, variety of opinion was the great characteristic of the sessions. For illustration, compare these views on collective bargaining and trades unionism:

Mr. Insull—Brains need no collective bargaining. Some classes of labor are better off with collective bargaining; others are better off

without it. I believe men above the average intelligence do not need it; those below do.

Mr. Fitzpatrick—The unrest is created by the grip of big business, which is never relaxed. The workers of the world have always been oppressed and have fonnd ways of getting relief. Collective bargaining is the agency.

Mr. Glenn—Labor unions are the enemies of civilization. The unions and the church cannot exist together.

Mr. Deibler—Collective bargaining is necessary to protect the interests of the employee.

Miss McDowell—Some unions are aristocratic. They limit membership and charge enormous initiation fees. We cannot get along without collective bargaining, but industry needs to be democratized.

Mr. Insull approached the general problem from a wide range of experience. He is in charge of utilities that have "open shops" and others that have "closed." He began at the bottom as a worker and is now in control of a long list of public utiiities. He is president of the Commonwealth Edison Company and of the Public Service Company af Nothern Illinois; chairman of the board of directors of the Peoples Gas Light and Coke Company; chairman of the executive committee of the corporation controlling the elevated railroads in Chicago and head of the Middle West Utilities Company.

Altogether the companies he directs employ 18,000 men, and his position is that labor organizations should not exist in public utility enterprises.

"In the Commonwealth Edison Company," he said, we have never had any serious trouble with our mechanical force. We do not deem it advisable to deal with labor organizations in public service corporations, which furnish business necessities to the public. Their first duty is to the public. If they were unionized, in case of a strike the operation of transportation would cease, the wheels of industry would stop, the public would suffer. Our function is a semi-governmental function, and the best evidence in our case is that we are not troubled with strikes. Then, too, there is no demand for organization in the gas and electric light and power business. We have a system of liberal pensions that is part of our contract with employees. Our policy is to interest our employees as proprietors in the securities of our companies. We believe in doing this as a matter of right and not as a favor. These figures may interest you. Out of 4,800 employees of the Commonwealth Edison Company 3,169 at present are able to subscribe to a fund for the acquirement of stock. Of these 1,983 are now in process of becoming part proprietors. We believe in the employees having a stake in the property and thus a stake in the community. Under such conditions the question whether a man is a member of a union or not does not arise."

Cleveland Gas "Meeters."—The second annual picnic, the East Ohio gas company employees was held under the auspices of Cleveland Gas "Meeters," at Meyers Lake, Canton, Ohio, July 18th, The sports indulged in comprised a ball game, Cleveland vs. Akron. Each man on the winning team and umpire receiving box of twelve cigars, and each player on both teams and umpire pack of "Lindsay Light" playing cards. Basket lunch, 12 noon. Band concert, 1 to 2:30 P.M., when the band was presented with silver loving cup in recognition of entertainment rendered. A drawing for "Reliable" gas range, 2 P.M., the purchaser of each numbered ticket having chance for this prize. Tug-of-war, East Side vs. West Side Shop, 1.30 P.M., participants on winning team receiving pipes. Running races, 2.30 P.M. Water sports, 4 P.M. More than 700 attended this very successful function which was made a family matter.

Public Policy and Publicity.—In the relation of the corporation to the newspaper is a power which may be made an asset and a valuable ally. said Mr. F. R. Slater in an address on "The Public Policy of Pubsic Utility Corporations" delivered before the Southwestern Electrical and Gas Association recently at Galveston, Tex.

"The reporter or news-writer," has the opportunity to put thoughts into the minds of thousands of men and women every day. Therefore the attitude of your officers toward the press is of the greatest importance to the welfare of your company.

"There is an inherent public belief that where there is fear there is wrong, and thus the repeated statement that a company is keeping something under cover poisons the public mind against the company. Public knowledge is disseminated through the press, and it is on the facts as they appear in the news columns of the country that public opinion is based. We may deny and decry the power of the press, but as long as people read newspapers, even newspapers whose policies they do not endorse they will be influenced by them."

The Campaign for Better Lighting.—That illuminating engineers are accomplishing something in the way of educating the public on the lines of demanding better instead of always brighter lighting, is evidenced by the many newspaper and magazine articles dealing with the subject. As an example we quote this from a recent issue of "The World's Work," under the title "Bad Lighting in the Home."

"Any kind of artificial lighting that produces glare is wrong in principle and its effect upon the eyes will be felt as inevitably as though the sun were hung in the room in the line of vision. A fixture over a polished table or in front of a mirror is as hard on the eyes as sunlight on white sand; indeed, it has much the same effect. The lights in a central chandelier of the direct type, hung low, strain the eyes and heat the brain; yet people wonder what gives them headaches in a dazzingly lighted room. It is a strain to distinguish people or objects in a room lighted in this way, yet you will see people shading their eyes with their hands while trying to read or work, and attributing the discomfort they feel to everything else than their 'artistic fixtures.' More often than not the fixtures, though perhaps having shades for the light sources, will have the lamps or mantles protruding above or below the edge of the shade, where the eye cannot possibly escape them. In an effort to have a room brightly lighted, shades and globes of clear glass are often used, subjecting the eyes and nerves to torture, and wasting lighting power. The lesson must be learned in the home as well as in the factory that the eye can see less with a brilliant, unshaded light source than it can with less light well protected."

Thimble Was First Gas Burner.—Professor Vivian B. Lewes gives this account of Wm. Murdock's first burner. "In the old days at Redruth, when making gas in his back yard and burning it in his office, to the wonderment of the rustics of the neighborhood, who could not understand the possibility of a flame without a wick—they had been brought up from childhood to the tallow dip and the oil lamp—Murdock first burned his gas simply as a flame from the end of a pipe, and when he wanted to cut off the gas, taking a small plug of clay he rammed it into the end of the pipe. You must remember that he had only just begun to experiment, and was not sure what would happen if the small holder in the yard was to ground and the pressure of the weight of the holder was to be taken off the gas. He had some sort of dim fear that there might be trouble, and when at one of his exhibitiions he saw his flame beginning to grow gradually smaller, he realized that the holder was getting low. He looked around for his plug of clay to cut off the light, but the plug had fallen to the floor and rolled under the table. Unable to find the plug, Murdock hurriedly looked around for something else, and saw his wife's thimble. Seizing the thimble, he rammed it over the end of the pipe. Smelling gas, he applied a light and found that the thimble was full of small holes drilled by the heads of darning needles, and the gas escaping through these holes ignited, and to his astonishment, Murdock saw that those few small jets of gas gave greater illumination than the great flare from the pipe. Working on this idea, he developed the Cockspur burner."

Use of Gas Growing.—The use of gas is increasing more than three times as fast as population. From 1900 to 1910 the increase in the urban population of the United States was 34.8 per cent. and during the same period the increase in the value of illuminating and heating gas produced was 120 per cent. This signifies an increasing rate of consumption per capita and consequent decreasing cost per thousand cubic feet. In the four boroughs of New York population grew 90 per cent. from 1890 to 1910, while in the seventeen years from 1893 to 1910 the gas sales increased 165 per cent. and the per capita consumption reached 8,350 cubic feet.

Dangerous Mining Conditions —There are two districts in Illinois where a combination of explosive gas and coal dust in the mines render mining operations very dangerous unless proper precautions are taken for the prevention of explosions. One of these, District V, comprises Saline and Gallatin counties in which are 33 mines. Bulletin 6, Coal Mining Practice in District V, by S. O. Andros, discusses safety measures necessary in the district and gives data on the mining methods used. The percentage of accidents caused by explosions is 32.1 for this district and 2.9 for the State as a whole. Each employee produces 5.1 tons of coal per working day while the average production per employee for Illinois is 4.5 tons; this high per capita production due to the extensive use of mining machines. Copies of the bulletin may be obtained upon request from the Illinois Coal Mining Investigations, Urbana, Ills.

(Continued from page 71.)

while to try and gain some definite information on ventilation in spaces as nearly as possible free from the accidental and capricious influences of what may be described as external factors; and the preliminary work in connection with this inquiry is contained in the following report.

It is intended to have experiments made eventually on ventilation as it occurs in actual buildings; but it was felt that in order to secure results which might be of permanent value, although perhaps not immediately applicable without modification to actual practice, it would be necessary to carry out a series of experiments under standard conditions. For this purpose it was decided to build a special room, so constructed that outside influences should be counteracted and the necessary standard conditions established.

The outside influences are:

1. Air currents, winds, and similar disturbances in the atmosphere.
2. Variations and large differences in temperature of the air inside and just outside the room.
3. Presence of warm bodies (human beings, etc.), and heat absorbing substances within the room.

The standard conditions to be established are:

1. Air entering the room must have as nearly as possible a constant temperature and chemical composition.
2. Air must enter and leave the room steadily, and, as far as possible, only through known openings.

After consideration, the main features of a construction which would satisfy these requirements were decided upon, thus:

The experimental room to be made of non-conducting material, as nearly airtight as possible, and enclosed in another room with sufficient space between to allow observations to be made; windows to be provided in the walls of the inner room for this purpose.

The outer room to be divided horizontally into two equal parts, to act as separate reservoirs for inlet and outlet air; so that the fresh air entering the inner room should not vary in composition by admixture with the vitiated air leaving it.

The openings between the outer room and the outside atmosphere to offer as much resistance as possible to disturbances of the air within the outer room by winds and air-currents in the outside atmosphere. For this purpose it was decided to make these openings of perforated material in the form of sieves, single or multiple, placed symmetrically above and below the dividing partition.

In order to minimize variations in temperature of the air in the outer room by heat communicated by the sun, and to make the building more resistant to atmospheric influences, it was decided to construct the outer and inner rooms of the same non-conducting material.

An explanatory drawing, Fig. 1, is appended.

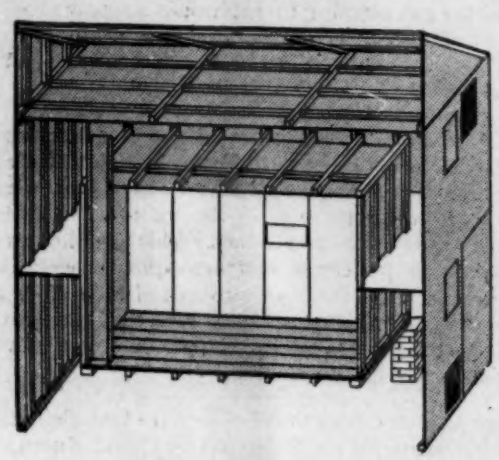


Fig. 1.

While these matters were being settled, preliminary experimental work was being carried out, one part of which had relation to the alleged liability of combustion products from gas-fires to escape under the canopy. For this purpose tests were made on four gas-fires, with and without the attachment of a flue pipe 18 inches high and 6 inches in diameter.

The results, given in detail below, seemed to show that, after the fires had been burning for some time, so that standard conditions had been attained, there was in most cases a very small, but determinable, escape of combustion products from under the canopy. Immediately after lighting the fire, this escape was more noticeable; but in every case the addition of the flue-pipe practically eliminated all escape. The usefulness of a short length of flue-pipe was thus indicated. The differences in the escape of products at the start—*i.e.*, in the first minute—with the various fires showed the design of the fire itself was of great importance in this connection.

For the above and other purposes it was essential to get a satisfactory means for the estimation of carbon dioxide. The method used previously by the Gas Heating Research Committee was first used, and eventually modified to make it more convenient. The method of collecting samples for analyses, consisting in exhausting a large bottle and allowing it to fill with the air, was retained. The main modification consisted in carrying out all the necessary titrations of barium hydrate in an atmosphere of air freed from carbon dioxide.

In order to obtain results without depending on the comparatively slow process of collecting samples of air for analysis, there was obviously considerable advantage to be gained by passing the gas continuously through barium hydrate solution and estimating the barium hydrate electrically, since the necessary measurements of electrical resistance could easily be made at frequent intervals; the decrease in conductivity representing the barium carbonate formed, and therefore the carbon dioxide absorbed. This method was worked out satisfactorily for flue gas determinations, but as yet has not been adapted successfully for the determination of carbon dioxide in air, where the quantities present are so much smaller.

It was also advisable for many purposes to be able to measure low pressures and low velocities of air; and experiments were made to ascertain what methods were available and what accuracy could be obtained.

It was considered likely that useful results might be forthcoming from the direct comparison of the air drawing power of gas-burners placed under determined and controllable conditions. For this purpose an apparatus, based on the principle used by Shaw in his experiments on air-currents and the laws of ventilation was designed, in which the burners were so placed that their drawing powers were brought into opposition; a detector being provided in the form of a delicately poised mica vane, to ascertain when a balance was obtained.

The results with this apparatus indicate that, as a laboratory measuring instrument, it is capable of yielding accurate and quantitative results; and it promises to be of considerable service for the purposes of this investigation.

Details of Experimental Work.—Pending the construction of the experimental room, preliminary experiments were made on the ventilating power of an old type gas-fire with a circular flue-vent 2¼ inches in diameter. These were carried out in the old experimental room used by the Gas Heating Research Committee, and described in their report. In order to obtain samples of constant composition, a perforated sampling pipe was fixed in the flue about 3 feet above the flue vent of the gas-fire. The quantity of air entering the room by the 3-inch opening, as determined by an anemometer, was about half that leaving by the flue, which was ascertained by chemical analysis. When the 3-inch opening was closed, about half the quantity of air passed up the flue. The experiments, although qualitative, showed that the amount of air drawn up a flue by a gas-fire depends on the resistance offered to the entrance of the air into the room. This is a point which is fairly obvious, but often neglected as of no importance, and proves the necessity for having standard conditions for testing the ventilating power of gas-fires. The resistance offered to the exit of air would also influence the results. A similar set of experiments carried out on a windy day under otherwise identical conditions gave different and variable results, showing how necessary it is to counteract the influence of external air currents as far as possible, to obtain very satisfactory results either when testing gas-fires experimentally or in actual use.

Tests were made with four gas-fires in order to determine the amount of products escaping in front of the canopy, and also the quantity of air passing through the flue vent when no flue pipe was used, and again when an 18-inch length of 6 inch diameter flue pipe was attached by means of adaptors.

The amount of combustion products passing in front of the canopy was determined immediately after the fire was lighted, and again when it had been burning some time. For this purpose a flexible lead hood was used which could be fitted to any of the gas-fires. The hood is quite open at the top and bottom so as not to interfere with the air-currents which are ordinarily set up when the fire is burning. A perforated brass pipe passes along the length of the hood for sampling the air within it. The hood is so made that it can

1	2	3	4	5	6	7	8	9	10	11	12
Gas-Fire, No.	Dimensions of Flue. Inches.	Area of Flue. Square Inches.	Distance B Inches.	Distance C. Inches.	Distance D. Inches.	Gas Consumption. Cubic Feet per Hour.	CO_2 Added to Canopy Gas at Start. Parts per 10 0 0.	CO_2 Added to Canopy Gas when Running. Parts per 10,000.	CO_2 in Flue Gases. Per Cent.	Approximate Volume of Gases Passing up Flue per Hour.	Approximate Volume of Gases Passing up Flue per Cubic Foot of Gas Burnt
1.....	12 6 by 2.4	30.0	4	3½	8	32.5	2.4	0.02	2.44	670	20.5
						32.6	2.2	0.35	2.22	730	22.5
1a.....	.....	....	..	..	..	32.4	0.5	0.3	0.83	1,950	60.0
2.....	9.0 by 2.3	21.0	1½	4½	7½	24.5	5.4	3.6	1.67	730	30.0
						28.4	9.1	3.1	1.70	830	29.0
3.....	10 by 1.6	16.0	3½	3½	5½	29.5	3.5	4.1	1.66	890	29.5
						29.5	3.4	4.2	1.63	880	30.5
4.....	9 by 1.3	11.5	1¼	1¼	5½	34.3	20.5	7.3	2.76	580	16.5
					4½	34.3	28.0	9.0	....	..	....
4a.....	.....	....	..	..	..	34.8	0.3	0.2	1.27	1,370	39.5

Note.—a With flue-pipe attached. Colnmns 4, 5 and 6 see Fig. 2. Column 8. "At start" signifies within the first minute after lighting the fire. Columns 11 and 12. Volumes in cubic feet calculated to normal temperature and pressure.

be divided into sections in order that determinations of the escape of combustion products from various points along the lower edge of the canopy can be made. A bent perforated pipe was used for taking the samples for analysis, from which the quantity of air passing through the vent was calculated.

The method used for determination of carbon dioxide was Letts' and Blake's modification of the Pattenkoffer method, in which a large sample of air was collected in a bottle coated inside with paraffin wax, and shaken up with a known volume of standard baryta solution. The excess of baryta was titrated with standard acid in an evacuated flask. The use of the evacuated flask was rather inconvenient, and was discarded. The titration was afterwards carried out in an atmosphere of air freed from carbon dioxide.

The apparatus used is shown in Fig. 5. *A* is an ordinary vacuum pump worked by water pressure. In ordinary use this pump draws air in at *B* and out at *C*. The lower end *C* is connected to a bottle *D*, and delivers the air and water into it. The water passes out through the tube *T* while air only passes out through the tube *E* into two towers—the first filled with wet caustic potash, the second with soda lime. In this way a continuous supply of air free from carbon dioxide is obtained, and may be got under pressure by adjusting the clip *P* so as to reduce the amount of air passing out by the tube *T*.

The air for analysis is collected in a large bottle, which is evacuated and allowed to fill with the gases. A known volume of standard baryta solution is forced in by carbon dioxide free air and, after shaking for some time, is transferred to the titrating vessel *F*, the bottle washed out, and the washings added to the solution. During this time carbon dioxide free air is passed continually through *F*, entering by the tube *M* and leaving by *N*. The excess of baryta is titrated by standard hydrochloric acid from a burette, the tip of which passes into the titrating vessel *F*. For the analysis of flue gases a smaller sampling bottle is used, and the titration carried out in the sampling bottle itself, in a similar manner to the above.

The method gives satisfaction; but the collecting of a large sample of gas by evacuating a large bottle and allowing it to fill is rather a slow process. For this reason, attempts were made to absorb the carbon dioxide from the air directly by passage through baryta solution. In order to determine the amount of baryta remaining in the solution without the necessity for removing it from the absorption vessel, an electrical method was devised, in which the electrical resistance of the solution was measured by the ordinary Wheatstone's bridge method before and after the absorption of carbon dioxide.

Determination of Small Differences in Air Pressure.—The first experiments were made with an existing gauge constructed on a recognized principle to enable small pressure differences to be measured. The apparatus consisted of two large bulbs connected by a narrow tube and containing immiscible liquids of nearly the same specific gravity. When there is a slight alteration in the level of the liquids in the two bulbs, the liquid flows along the narrow tube and alters the position of the line of demarcation between the liquids. With aniline and water, this separating line was not always clear, and did not come to rest in the same place after pressure had been removed from one or the other bulb. According to Prof. Thompson, with paraffin and acqueous alcohol much better results could be obtained; but when the apparatus was modified, to make it more sensitive, the two bulbs being connected by a long narrow tube placed horizontally, the line of demarcation fluctuated in position probably owing to changes in temperature. As a further modification, the whole apparatus was filled with water, and a globule of benzene introduced into the narrow tube to act as an indicator of the flow of water caused by a difference in level between the liquids in the two bulbs.

The apparatus appeared to give good results when pressure was always applied at the same bulb; the globule of benzene moving along the tube for a distance equal to 200 times the difference in level between the liquids in the two bulbs. However, when pressure had been applied at the other side and removed, the globule did not return to the same position as before; being about 6 cm. from its previous position.

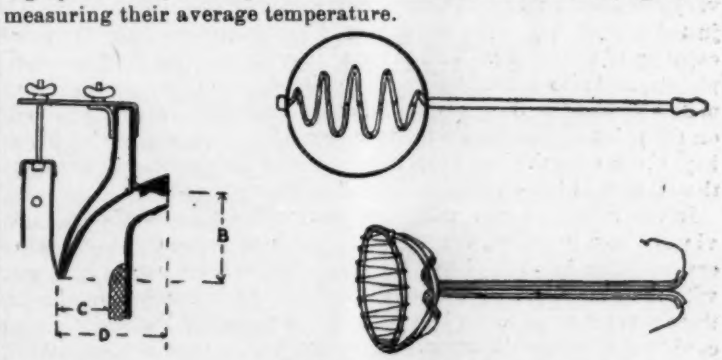
It appears from these results that an apparatus of a type similar to those mentioned would be suitable for certain purposes, but would have to be considerably modified to be used for absolute determination of very small differences in pressure.

Direct Comparison of the Drawing Power of Gas Burners.—It is known that the drawing power of a burner must depend on the resistance offered to the entry of air into the room or space from which the burner is extracting air. An apparatus was, therefore, designed in which this resistance was controllable.

The apparatus (Fig. 6) consists of two similar air-tight boxes *A A1* fitted with flues *F F1* of the same size, and adjustable opening *O O1* for the entry of air into the apparatus. Under the flues the burners *B B1* are placed, and when burning, draw air through the openings *O O1* and up the flues. The boxes are connected by a glass tube *T*, containing a delicately balanced mica vane attached to a small magnet as a detector of air currents. A magnet *M* placed under the detector serves to bring it to a zero position when there is no current along the tube.

When in use each burner creates a certain head; and if the openings for the entry of air into the boxes are equal, the burner with the stronger drawing power draws air from the other box along the connecting tube *T*. By adjusting the openings a condition can be established in which no air flows along the connecting tube. In this condition the heads produced in the flues by the two burners bear the inverse relation to the squares of the areas of opening into the boxes in which they are placed, providing the flues have the same pneumatic resistance. A comparison between the drawing power of two burners can be made in this way, or of any one burner against the standard.

A bent perforated pipe (Fig. 3) is used for sampling the gases passing up the flue, and a platinum resistance thermometer (Fig. 4) for measuring their average temperature.



Figs. 2, 3 and 4.

Professor Cobb emphasized that the report was only of a preliminary character. The real substance of what they had done was dealt with by Mr. Harrison, but there was one point with which he, natur-

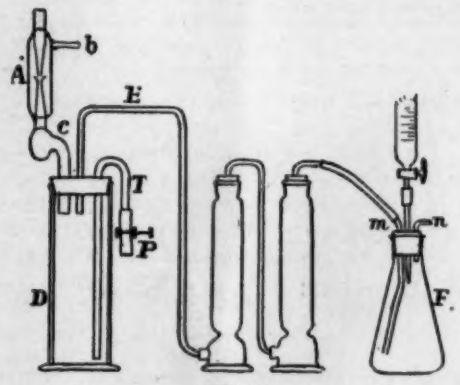


Fig. 5.

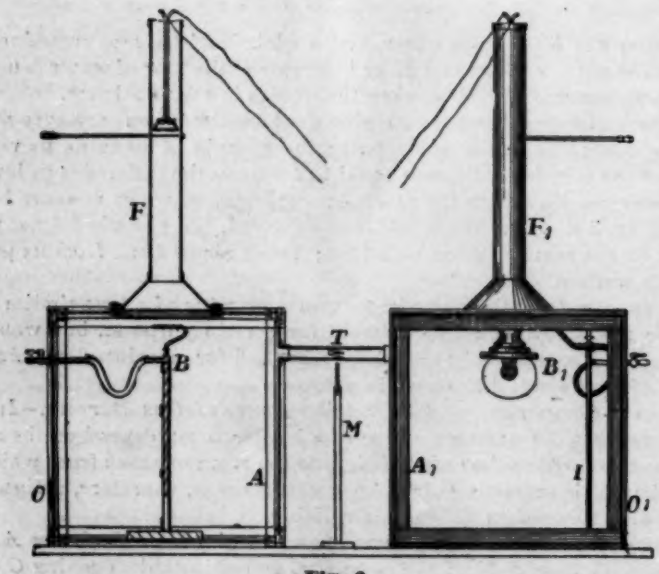


Fig. 6.

ally, had not dealt. The committee appreciated the ability and ingenuity displayed by Mr. Harrison in applying himself to this work. He was to be congratulated more than any other individual upon the real and material achievement in having sufficient material for even a preliminary report at this stage.

Inspection and Maintenance of Automatic Water Heaters.

[Read by Mr. Guy F. Gregg, before Wisconsin Gas Association.]

This season, for the first time, we have made a thorough inspection of the automatic water heaters in service in Milwaukee (of which there are about eight hundred to a thousand installed) and have discovered some very interesting facts. By experimenting, we found that practically all water heaters could operate successfully with No. 44 spuds in Milwaukee, that is we could get the capacity of the heater with water at 140° with that size orifice. In our investigation we found heaters equipped with spuds running from No. 46 to No. 40, very few above, many of these heaters having the water valve adjusted so that they were delivering 2 to 2½ gallons over the rated capacity of the heater. This resulted in a great many high bill complaints, and also caused too much condensation in the heaters. One man who had No. 38 spuds, and thought his gas bills too high, was on the point of throwing out the heater. The burners could not be kept clean with the large orifices and the gas consumption was more than it should have been.

In one house where a return system with a coal heater had previously been installed, the stop cock had been opened by some painters working in the celler, allowing cold water to continually mix with the hot water. We were advised that he had had a plumber up there several times to see if it could not be remedied, but the plumber could not discover the cause. We also found at least a dozen heaters without check valves in the hot water lead. With check valves the hot water is not drained off, resulting in quicker service and less gas consumption. We found numerous water valves leaking, others sticking, making it necessary to take out the disc, clean plunger, etc.; and two automatic heaters without any flue connections. In another case there was a lack of water pressure, and we had to put a weaker compression spring in the water valve to take care of it.

Hundreds of heaters of course needed cleaning, some due to too large orifices, and others to the location of the heater. In three cases we found heaters installed alongside of the furnace, and customers advised that there was no use cleaning them because they got dirty in a couple of weeks. We explained to them this was due to the fact that if ashes were removed during the time the heater was in operation, the dust was drawn into the burners, and we received orders to change location of heaters. One large wholesale house thanked us very much for calling attention to the fact that their heater needed cleaning. and asked us to keep up our inspection, and clean it when necessary. They had noticed that they were not getting hot water as quickly as when the heater was first installed, but did not know the cause. In another case, a customer who asked us to change the orifices in his heater, said that his man cleaned it. When we were changing the spuds the hired man, who was supposed to be keeping the heater clean, was asked how he did it, and we found that all he did was to dust and wipe off the burners and coils. When it was explained to the owner that the gauzes had to be taken out and cleaned, he immediately told us to clean them properly, and replace three or four burners which had been broken.

In Wauwatosa, which we supply with gas, the water contains a large percentage of lime, and in cases where there was no reservoir, we found the coils of the heaters in very bad shape. It was clearly demonstrated that in setting automatic water heaters in this district in the future we will have to insist that reservoirs, such as a 30 or 40 gallon boiler, be furnished from which to take the water into the heater, and that it be drained out at least once a week. While this will not entirely remove the difficulty, it will help.

One of the worst cases we had was from one of our large wholesalers, who had made numerous high bill complaints. In this case we found a pipe leading from the return system running from the hot water connection in the laundry down under the cement floor and to the front of his house, a distance of 80 feet, and then into the return system of heating. There was a leak in this pipe underneath the floor and all the hot water that was left in the system after closing the faucets upstairs, drained out. It took considerable work on our part to convince the plumber that he had not cut off this pipe when the heater was installed. Another case where we had considerable trouble was in a shampooing establishment. In this case the automatic heater was located in the basement, and on the first floor there were two shampooing outfits and faucets in the kitchen for hot and cold water. The cold water supply extended through the ceiling of the basement into the automatic heater. The two faucets for shampooing were connected together by a central control cock used to regulate the flow of the water. By turning off the central control cock and leaving the cold and hot water faucets open, the cold water would force itself into the hot water faucet, due to having more pressure, and when hot water was drawn through the kitchen faucet cold water would flow from both faucets into the shampooing basins; the cold water passing over the hot water riser from the automatic heater. We overcame this trouble by placing a check valve in the hot water riser to the shampooing faucets. We also discovered numerous water heaters in such bad condition that they have not been in use for some time.

We have had some very complimentary letters from people thanking us for the work we are doing, and we are sure it will pay in the end.

We have also had two cases of heaters installed in old houses by plumbers, who did not notify us to change the meters and people were not getting results owing to small meters.

Spitzglass Double Slide Rule and Computer.

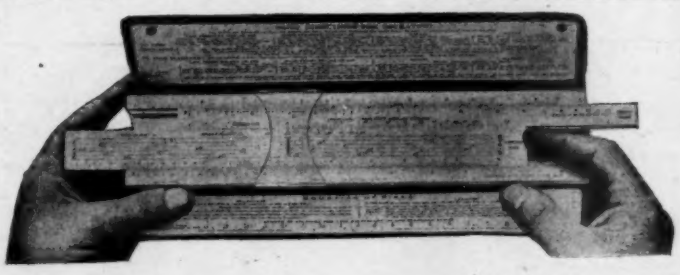
For Direct Solution of Problems Involving Flow of Gas, Air, Steam or Water in Cylindrical Pipes; in Addition to Ordinary Slide Rule Computations.

There has been so many special slide rules offered for the solving of engineering problems that it seems advisable in introducing a new rule to explain its necessity so that it will not be placed in that general class. We wish, therefore, to emphasize that in the first place this device is a general slide rule as well as being capable of much broader usage. It contains many valuable improvements over the ordinary type, and in addition offers a direct solution for all problems involving the flow of fluids in pipes. The special features of this slide rule are the result of many years of experimental work,

combined with a careful study of the subject of the flow of fluids in pipes. The ordinary methods used in solving such problems, up to the present time, have required the determination of special formulæ for each particular case; and even after the formulæ were determined much time and tedious work were still required when the occasion for using the formulæ presented itself. With this slide rule all of the work connected with the figuring of such problems has been practically eliminated.

This slide rule will, therefore, prove of great benefit to all members of the engineering professions as well as to mechanics dealing with the installation of piping systems. Those who are familiar with the advantages of the regular slide rule will find that by making use of this double slide rule they will save many hours of tedious work. On the other hand, those who have never used a regular slide rule will find no difficulty in mastering this one, as the principles involved in its operation are as simple as those of ordinary arithmetic.

The operation of this rule is entirely different from that of the ordinary slide rule, and much more simple. Each quantity involved in the figuring of problems dealing with "Flow of Fluids through Pipes" is assigned to a separate scale as indicated on the face of the rule. The required answers are read from the scales directly, with the accuracy and precision of the ordinary slide rule, but without the necessity of manipulating the decimal point, or the number of integer places in the answer. The rule is made of solid celluloid, and is permanently attached to a leather case. Brief directions for the operation of the rule are printed on the inside of the cover, so that when it is unfolded, they are conveniently before the operator. The rule has two slides of solid celluloid accurately fitted to work in separate grooves. The slides are reversible, one side being used for gas or air flow problems; the other, printed in a different color, for problems dealing with steam or water flow.



Referring to the cut, the familiar A, B, C, D slide rule scales are noted, being marked on the left end. On the right end, and in the middle, the scales are marked for the special features of the rule. Two scales are set on the stationary part of the Rule; the top or "A" scale, marked "Drop in Pounds, Feet or Inches" and the bottom, or "D" scales, marked "Discharge in Cubic Feet, Pounds or Gallons." The scales are to be read according to the fluid in question, in each case the unit usually employed being given in the directions on the cover. The "B" scale is on the upper, or "Length" slide, and is marked "Length in Miles, or 100 Feet" for Gas and Air (High Pressure and Low Pressure respectively) and "Length in 100 Feet" on the "steam and water" face of the slide. On the lower edge of the Length Slide is given a special scale marked "Mean gauge pressure in pounds," and an arrow head corresponding with the 12 pound reading on the gas and air face is marked "Gravity Mark" to be used in connection with low pressure gas and air problems. A scale, marked "Specific Gravity," (air equals 1) is given on the top edge of the diameter slide for gas and air, and a logarithm, or equal division scale, is given on the corresponding edge of the "Steam and Water" slide. An arrow head corresponding with 7.96 on the logarithm scale is marked "Pressure Mark" to be used in connection with steam flow problems.

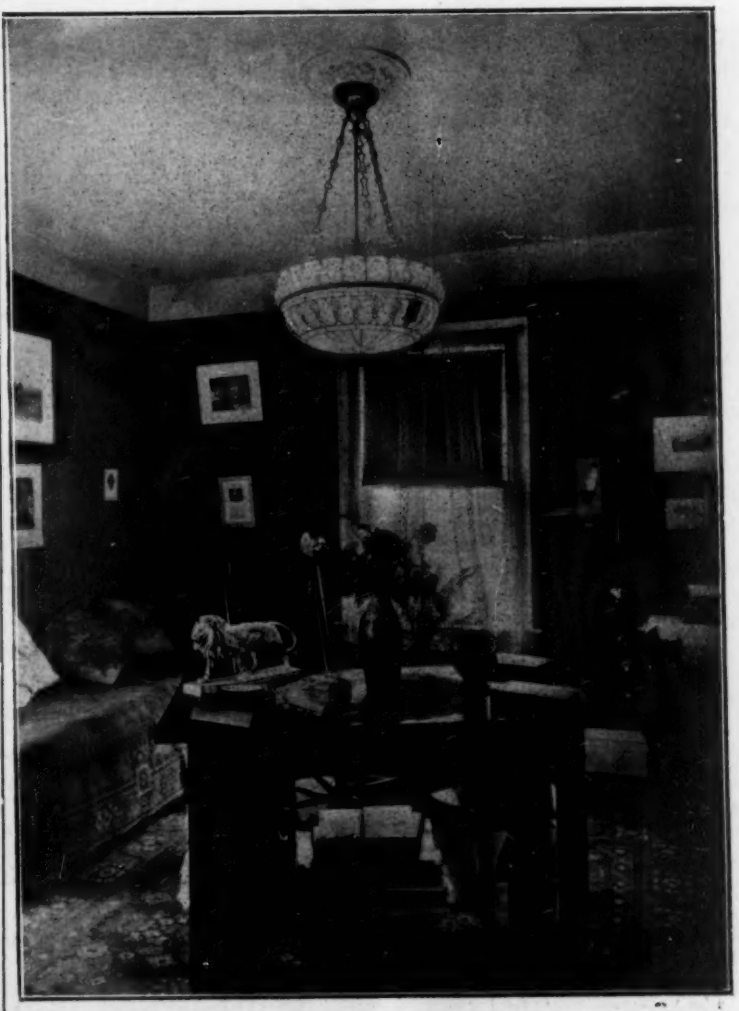
The main special feature of the rule is the plotting of the diameter lines in five horizontal rows on the diameter slide. These are marked in order from ¾ inch to 48 inch diameter pipe. The line for each diameter is extended over the "C" scale (set on the lower edge of the diameter slide) to meet and indicate corresponding readings on the "D" or discharge scale. One column of heavy type figures in the middle of the slide and one on each end, indicate the number of integer places in the discharge corresponding to the diameters of each horizontal row.

A brief series of directions for operation are printed on the folder enclosing the rule. These will prove sufficient for operating the rule in most cases, but for the benefit of those desirous of familiarizing themselves with the operation in every detail, a complete set of directions, supplemented by typical examples and suggestive details, and conveniently subdivided into the general classes of problems for which the rule is intended is published in the form of a manual and sent with each slide rule.

The Spitzglass Double Slide Rule and Computer is sold by this JOURNAL, see advertisement on page 13 of the advertising section.

New Methods and Appliances.

AN EXAMPLE OF GOOD DOMESTIC LIGHTING.—The photograph shows a living room lighted by an "Equalite" semi-indirect fixture suitable for either one or two inverted lamps. This combination gives quite efficient and pleasing distribution of light, and is highly ornamental in itself. It is one of the newer designs of Bayley & Sons.



NEW BURNER PRINCIPLE.—The Engineering Research Laboratories of the Welsbach Company announce that the application of recently discovered principle of gas lamp design has resulted in the commercial development of a type of lamp by which operating costs are practically cut in two. This parallels the development of the nitrogen-filled Tungsten lamp in the electrical field. In addition the necessity for the use of cylinders is avoided and the new type of burner requires attention and adjustment at very infrequent intervals. It is noiseless and non-carbonizing, very inexpensive and simple of construction; may be applied in fixture design with almost the same flexibility as the electric incandescent lamp, and fixture discoloration is eliminated. The new lamp operates on novel principles in that the kinetic energy of the gas is fully utilized to secure uniformity of mixture, which is accomplished by providing scientifically designed stream-lines for the gases. This development is the culmination of three years' research in connection with the behavior of gases in the Bunsen burner, and it is the first exhaustive work ever done in this direction. The importance of the principle

discovered is illustrated by an experiment upon the existing burner, which by mere chance happened to approach quite closely to the design found to be scientifically correct. The alteration of one or two apparently insignificant features increased the efficiency over 70 per cent. and rendered the cylinder superfluous. The necessity for extreme care in design lies in the fact that gases highly expanded and heated are greatly affected by conditions of almost infinitesimal nature.

Lamps constructed upon these principles have been in operation under service conditions 24 hours a day for a period of over 1 year. During this time they were subjected to extreme changes in gas pressure and quality, and it has been found impossible to carbonize the mantle or to make the lamp flash back, and though the lamps have never been turned off, even for cleaning, there is no observable depreciation in candle power, and the mantles are all intact.

Officials of the Welsbach Company regard this as the most revolutionary development in gas lighting since the time of Welsbach.

This kinetic type of burner will be placed on the market in the medium sizes within a short time and will later be developed in units ranging from 100 to 1,200 candle power.

Surface Combustion in Steam Raising.—In a recent lecture before the Royal Society of Arts Professor W. A. Bone spoke particularly of surface combustion applied to boilers. Firing with solid fuels, the engineer had been content with a thermal efficiency of 70 to 75 per cent., with an hourly evaporation of 5 lbs. to 8 lbs. per square foot of heating surface. When it was realized that such a rate of evaporation represented a heat transmission of less than 1 per cent. of the maximum conducting capacity of the tubes, assuming an average difference of 1.000° F. between the mean temperature of the products of combustion and that of the water surrounding the tubes the wide margin for improvement is evident.

This unsatisfactory state of things is principally due to the formation on the underside of the tube, of a feebly conducting and practically stagnant film of gas (about $\frac{1}{16}$ inch thick) at relatively low temperature, which, in existing boiler designs, opposes the passage of heat from the burned gases to the water. Professor Dalby concludes that of the total "temperature head" about 97 per cent. is required to overcome the resistance of the gas film, a further 2 per cent. to overcome the resistance of a similar film of water on the other side, leaving only 1 per cent. effective heat transmitted across the metal of the tube.

It has been demonstrated that the retarding influences of this gas film upon the heat transmission can be lessened by increasing the velocity of the burned products through the boiler tubes, but it is not generally recognized that, inasmuch as gases are practically transparent to radiant heat, the best way is to make the fullest use of radiation, and rely as little as possible on the sensible heat of the burned products for, so far as its influence upon radiant energy is concerned, the gas film may be considered as non-existent.

Heretofore gas firing for steam boilers has not been very successful in point of thermal efficiency or rate of evaporation. He attributes this circumstance to the fact that the engineer, with singular lack of imagination and disregard of the principles of gaseous combustion, has persisted in constructing gas-fired boilers in substantial accordance with the stereotyped designs for coal-firing. The result has been that while the substitution of gaseous fuel for solid fuel in industrial operations has invariably made for economy, existing types of gas-fired boilers are, as a rule, less efficient than the same boilers when coal-fired.

It was the contemplation of the really wicked inefficiency of blast-furnaces gas-fired boilers that impelled him to transfer his surface combustion researches from the laboratory to the factory; with the result that a boiler had been devised in which they were able to obtain, with coal gas or coke-oven gas, a heat transmission of 92 to 94 per cent. of the net calorific value of the gas to the water in the boiler, in addition to having an enormous gain in the rate of evaporation as compared with the best contemporary boiler practice; and he was not sure that they had yet reached the maximum limits of rate of evaporation.

Phenomenal Patent Issue.—During the week of July 14 the United States Patent Office issued 907 patents, the largest number granted during any week in the history of the institution. The Patent Office receipts for April, May and June were also unusually large, being $601,137.67 for the quarter. During the year ended June 30, an average of 1330 patent applications were filed and 690 patents issued each week. while during the previous year 1310 applications were filed and 670 patents patents issued weekly. During the first half of 1913 the average weekly issue of patents was 660 compared with 730 for the same half of 1914. With the opening of 1914 31,900 applications were awaiting action, while on July 1 only 22,400 remained to be passed upon, showing for the six months a decrease of 9,500 in the applications pending.

Items of Interest
FROM VARIOUS LOCALITIES.

Efforts are being made by a utilities corporation of Pennsylvania to merge all the public service companies on the Eastern Shore and lower Delaware into one concern. The companies under consideration are the Salisbury Light, Heat and Power Company; the Home Gas Company; the Salisbury Water Company; the Sussex Light and Power Company, of Laurel, Seaford and Delmar; the South Delaware Gas Company, of Seaford; the Cambridge Light and Gas Company; the Georgetown Light and Fuel Company, and the Easton Gas Light and Fuel Company. The consulting engineer who is at work on the combination, has been looking over some of the properties and will examine and report on all of them. After his reports go in it is said a proposition will be made the various companies for their properties. The promoters of the combination urge extensive economies under a single management as one of the main reasons for consolidation. The capitalization of the new concern would be in the neighborhood of $1,500,000, and it is estimated that the gross earnings of the various companies would show a return of at least 8 per cent. on this capitalization.

With the serving of a summons on officers of the South Shore Gas Company, of Babylon, N. Y., the first step was taken in a contemplated suit by Mrs. Reid to compel the gas company to remove from the Crescent a line of pipe laid recently. This suit is the latest of a number of legal actions now pending, all having as their fundamental object the establishment of the ownership of what the village authorities call Crescent avenue. Mrs. Reid, and other property owners on the Crescent, have maintained that this road runs through private property, while the village trustees wish to regard it as a public highway. The gas company wished to reach the Kingsland property, which is being developed, and in order to do so was compelled to go through the Crescent, so procured a permit from the village and put the main in on a Sunday. Mrs. Reid now intends to sue the gas company for trespass, and in order to prove that they were justified in granting the permit, the village authorities will be compelled to prove their jurisdiction over the road.

The Rockford (Ills.) Gas Light and Coke Company is extending its service by laying about 5,000 feet of mains on Kishwaukee street from Eighteenth avenue to Twenty-third avenue and on Twenty-third avenue to Sixth street to reach the J. L. Clark Manufacturing plant and the new Spengler Bros. factory which will be equipped with modern gas appliances. The sliding scale rates for industrial gas are getting the company a large quantity of such consumption.

Superintendent Butler of the Greenfield (Mass.) Gas Light Company has been demonstrating a safety shut-off devise to be installed in an iron box on the outside of buildings, for which the gas company and the fire department will have keys. He also has a device by which the meter in a burning building will be shut.off by the fusing of a metal strip. The devices were perfected by Mr. Sullivan of Holyoke and have been generally adopted on public buildings in Holyoke, Springfield, Northampton, Pittsfield and other places. Fire Commissioner Cole of Boston says: "All buildings other than dwelling houses should be equipped with gas shut-offs, either automatic or manual that can be operated from the outside."

The old gas plant on East Crocker street and Columbus avenue, Fostoria, O., and comprising an acre of land, which has been the property of C. A. Guernsey since it was sold at receiver's sale a number of years ago, has been purchased by J. W. Lockhart, F. Gerlinger and F. Gebert, who hope to locate a number of small manufacturing institutions thereon.

On and after August 1 any city or town in Massachusetts, according to the terms of a recent enactment, can "construct, purchase or lease and maintain within its limits, one or more plants for the manufacture or distribution of gas or electricity for municipal use or for use of its inhabitants except for the operation of electric cars. Such plants may include suitable land, structures and machinery and other apparatus and appliances for manufacturing, using and distributing gas or electricity for said purposes. A city shall not acquire such a plant until it has been so authorized by a vote of two-thirds of each branch of its city council or of two-thirds of the members of a single

legislative board if the city council is so constituted, or of a majority of the commissioners where the city government consists of a commission, passed in each of two consecutive municipal years and thereafter ratified by a majority of the voters at an annual or special city election. If such vote is not ratified, no similar vote shall be submitted for ratification within one year thereafter. Such vote of the city council or corresponding body shall be subject to the approval or disapproval of the mayor."

EXCAVATIONS for installing gas service in Houston Heights to connect with the plant of the Houston (Tex.) Gas and Fuel Company, will be begun not later than August 1, according to the latest information received in Houston from the New York office of the company. All the pipe has been ordered and a large portion of it is en route for laying 30 miles of gas mains. The contract for the construction has been let. The greater portion of the service will be laid in alleys, greatly simplifying the work of making connections with houses.

AN automatic gas machine exploded in the dry goods store of Joseph Muller at 65 Market street, Newark, N. J., and 5 men who were arranging the stock had to flee. The blaze spread to the basement, and a billiard parlor of W. E. Huntley on the second floor and burned through the roof. The damage was $5,000.

THE work of beautifying the grounds about the new gas holder of the Rochester Railway and Light Company, in Brighton, N. Y., is almost completed, and a very pretty park it makes. The holder itself has donned a coat of dull gray, which is somewhat more soothing to the nerves than the brilliant red that had adorned it since its erection. The original intention of the company had been to build the big holder on property purchased in the Eighteenth Ward, but the neighbors successfully protested against it being erected in their vicinity. Now it is reported that they are casting envious eyes at the little beauty spot in Brighton, and have started a movement to ask the company to beautify the barren piece of ground on which it had intended placing the tank, had the protest not prevented. It is known that the intention of the company, when the gas holder proposition was abandoned, was to make a storage yard of the property.

THE Tower Grove grade crossing controversy, in St. Louis, Mo., in which the Laclede Gas Light Company refuses to remove, at its own expense, a 24-inch high pressure main, which is blocking completion of the viaduct being constructed to eliminate the surface crossing, may be settled by the Circuit Court on a decision to be based on an agreed statement of facts submitted by all parties concerned. The viaduct is nearly completed and there is much speculation as to the next move of the railroads. Lest the pipe be broken by parties not in sympathy with the attitude of the gas company, watchmen have been stationed at the scene. The pipe now rests about 8 feet above the railroad tracks and is exposed for 32 feet. The only cars which can operate on the track are those carrying dirt and which are a few inches lower than the pipe. The Vandeventer car tracks lie to the east of the pipe about 40 feet. The breakage of the pipe would mean that several hundred homes in South St. Louis would be without gas, and the gas company has placed an emergency valve near, which can shut off the gas immediately if the pipe should be broken.

MR. CARROLL MILLER, engineer of the Providence (R. I.) Gas Company, has tendered his resignation and will shortly sever his connection with the company. It is reported that he will become general manager of the Western United Gas and Electric Company of Aurora, Ills.

THE seventh annual outing of the Pittsfield (Mass.) Coal Gas Company Employees' Association was held July 22 at the Williams farm. Ideal weather conditions prevailed and the large attendance made the affair one of the most successful in the history of the organization. The party left the company's offices about 8 o'clock in automobiles and immediately upon the arrival at the farm, a well-selected card of athletic events was run off as follows:

100-yard dash, won by Arthur Wright.
Three-legged race, won by Arthur Wright and Patrick Lynch.
Sack race, won by J. Frank.
Potato race, won by John Welsh.
Fat men's race, won by R. Kilian.
Shot put, won by Michael Connors.

Suitable prizes were awarded the first three men in each contest. Following these events there was a baseball game between two teams, the "Regulars" and the "Pre-payments," the latter winning by the score of 2 to 1 after 11 innings. At 1 o'clock an excellent chicken dinner was served in the grove, and following the dinner a short business meeting was held at which the prizes were distributed. In the afternoon the married men defeated the single men in a tug-of-war. The single men had their revenge, however, in the ball game that followed when they succeeded in defeating the married brethren by a score of 5 to 2. Refreshments were later served and a group photograph taken. The outing committee comprised: James Hurley, Richard Schiemenz, David Cullen, Jr., Patrick Lynch, James Griffin, Horace Trego and Michael Connors.

MR. ARTHUR S. HALL, of Melrose, has been appointed temporary, and possibly permanent, Superintendent of the Springfield (Mass.) Gas Light Company's plant. Mr. Hall succeeds Benjamin P. Bill, who has been granted a vacation until October 1. At the conclusion of his vacation Mr. Bill may return to the superintendency of the local plant or be transferred to some other plant of the Tenney syndicate.

MR. R. M. PARKER, for the past six years manager of the Fort Dodge (Ia.) Gas and Electric Company retires from that position with the cordial good will of his company and business associates as well as the public generally, to enter the insurance business. The management of the Fort Dodge Gas and Electric Company, made vacant by Mr. Parker's resignation, will hereafter be held by R. B. McDonald, who has been superintendent of the plant for about seven years and was the logical appointee for the vacant place.

THE shells for the new generating apparatus purchased by the Orlando (Fla.) Water and Light Company have arrived and are being installed. The machine is of the most up-to-date type, manufactured by the United Gas Improvement Company, of Philadelphia, and will have a total capacity of 300,000 cubic feet of gas per 24 hours.

ONE of Paxton's (Ills.) most thriving enterprises is the Paxton Gas Company, organized about a year ago by home capital. In spite of the advice of the skeptical, the work of building the plant went right on, and to-day the company has about 250 meters in operation and more in sight. The output of gas by the company is greater for the time the plant has been in operation than that of many other cities larger than Paxton. The increasing demand for gas has made it necessary to add another storage tank which increases the capacity of the plant to 50,000 cubic feet. The plant is in charge of Mr. T. E. Larson, and the management of the company is in the hands of men of well known business ability and the success of the company is due to them. The salesroom of the company on Market street is in charge of W. H. Hunter, the manager, and is a model store of its kind.

THE Macon (Ga.) Gas Company has filed answer to the suit for injunction recently brought by S. J. Dannenberg in an effort to restrain the increase in the capital stock. The answer alleges that Mr. Dannenberg purchased ten shares of stock solely for the purpose of being a nuisance, so that he could "force an unconscionable price" for it from the company by objecting to any plans of development. It is set out that he has no real interest, but simply wants to oppose the wishes of the majority. It is denied that the A. B. Leach interests sought to remove the Macon Gas Company from competition in the electric field, or that the Central Georgia Power Company has any interest in the Macon Gas Company. The charge is also made that "Mr. Dannenberg once before succeeded in forcing a large corporation to pay him a high value for his stock and that he has conceived the idea that by obstructing the reorganization of the Macon Gas Company he could obtain a large sum of money for his stock."

THE Bridgeport (Conn.) Gas Light Company has installed new lighting service in the bandstand at Washington park. The improvement is marked and is greatly appreciated by members of the bands who have long felt that the lighting arrangement at the park was inadequate. For several years the gas company has provided free lighting service for the bandstand at Seaside park and Manager Roberts agreed to lay a new service through the park, without cost to the city and to provide free gas for the bandstand. The only expenses to the city was the purchase of four gas arc lights and as long as the bandstand is used the gas company will provide the service gratuitously, a concession which the park board much appreciates.

Utilities Commission News.

IDAHO COMMISSION ATTACKED.—The Public Utilities Commission of Idaho is under attack. The Republican and Democratic State Conventions having inserted planks in their respective platforms providing for the amendment of the utilities act.

It is said by those who are familiar with the intent of the Republican plank that it means a declaration for an amendment to the utilities act that will take from the commission power to require companies to apply for certificates of public convenience and necessity before competing in districts where corporations are operating and reasonable rates prevail.

The democratic platform says in part: "The law has been interpreted by the Republican Commission and affirmed by the Supreme Court of the State of Idaho as giving the commission sole and autocratic power to permit existing public utility monopolies to continue their exclusive possession of the market supplied by them; competition is killed; the needed and desired development of Idaho's natural resources is blocked and discouraged. We condemn this substitution of three man commission rule for the public policy of competition and development of natural resources. We pledge the Democratic party to such changes in the public utilities law as will secure regulated competition in place of protected monopoly."

COMPANIES TO PAY EXPENSE OF COMMISSION.—Governor Walsh of Massachusetts has sent a special message to the Legislature recommending that a law be passed by which the cost of maintaining the Public Service Commission shall be assessed upon the companies under the boards' supervision. In the message it was pointed out that under existing laws companies under the supervision of the Gas and Electric Light Commission pay the cost of that board and that a similar statute regarding the Public Service Commission would save the state $200,000 a year. The message was referred to the committee on railroads which voted to refer the matter to the next Legislature.

ORDERS MAIN EXTENSIONS.—The Indiana Public Service Commission has ordered the Citizens Gas Company of Indianapolis to install 22,211 feet of mains in addition to the quantity it is required to install every year under the lease approved by the Commission. The Company had agreed to waive hearings on the petitions of persons wanting gas mains to the extent of 22,211 feet, but when the City Board of Public Works asked that 36,065 feet be installed, the Company said the additional mains would not provide a revenue sufficient to justify installation.

The order did not provide for an issue of bonds to cover the cost of installation, and at the last hearing before the Commission, J. D. Forrest, General Manager of the Company, said it might not be necessary to ask for a bond issue.

MARYLAND STANDARDS.—The Public Service Commission, of Maryland, will call a conference of representatives of all the gas companies in the State with the view to establishing standards of candle power, heating value, purity of gas and for pressure and methods of testing meters. The date set for the conference is September 22.

Speaking of the objects in view, Chairman Laird said:

"This subject has been in mind for a long time. It was inevitable, perhaps, after the reduction in the price of gas, that complaints such as have been made to the Commission and through the press should find voice, and the steps now to be taken would have been started earlier but for the fact that there was some doubt about the extent of the Commission's power to fix standards, and it was deemed inadvisable to attempt it until all doubt was removed by amendment of the law, which was accomplished at the last session of the Legislature."

ALLOWS EIGHT PER CENT. RETURN.—The Railroad Commission of California has rendered a decision in the complaint brought by the city of Monterey against the Coast Valleys Gas & Electric Company charging that the gas company's rates were unreasonable. The gas company denied this and asked the commission to fix rates which would allow a return of 10 per cent. on the full estimated reproduction cost of its property. The rates as finally determined by the commission will reduce the maximum rate charged by the gas company from $1.50 to $1 30 per 1,000 cubic feet. It is estimated that the rates as established by the commission will allow the gas company a return of 8 per cent. on the commission's valuation of the property.

Financial Notes.

THE Laclede Gas Light Company, St. Louis, Mo., reports for the six months ended June 30 as follows:

		Increase.
Gross earnings	$2,348,171	$65,910
Expenses and taxes	1,183,823	68,016
Net income	1,164,348	*2,106
Depreciation	141,967	3,990
Balance	1,022,381	*6,096
Interest and preferred div	615,328	33,336
Balance for common div	407,053	*39,432

*Decrease.

THE Peoples Gas Light & Coke Co., Chicago, has declared the regular quarterly dividend of 2 per cent. payable August 25 to holders of record August 21.

THE Pacific Gas & Electric Company says in a circular to stockholders:

"The culmination of this plan will place the company in a strong financial position – with short time notes and other floating debt paid, a large cash working capital and $5,000,000 of free bonds in the treasury for future development. The directors have pledged a resumption of dividends on the common stock of 1 per cent. quarterly, beginning the first of next year, provided the plan becomes operative.

"Owning to the condition of the market it was not feasible to sell the stock except to shareholders of company, and the railroad commission of California recognized this in permitting the sale at so attractive a price."

THE Maryland Appeal Tax Court has increased the 1914 assessment against the Consolidated Gas, Electric Light and Power Company, of Baltimore, to the extent of $2,300,000, adding $45,000 in round figures to the Company's city and State tax bill. The increase was as follows: On gas mains and appliances, $1,800,000; on electric appliances, $500,000.

The total assessment against the Company now aggregates $14,000,000 exclusive of its shares of stock. Of this about $6,000,000 represents real estate, which has not been reassessed since 1913, and the remaining $8,000,000 is made up of easements, gas mains and appliances, electric appliances, poles, etc.

THE Clinton Gas and Electric Company, and the Clinton Street Railway Company, of Clinton, Ia., filed amended articles of incorporation with the Secretary of State recently making a large increase in the amount of capital stock.

The gas and electric company moved its capital up to $1,250,000, thereby increasing it $500,000. The city railway company added $400,000 to its capitalization, making the total $1,000,000.

MASSACHUSETTS gas subsidiaries closed the fiscal year with a decrease in the surplus for dividends of $36,453 for June, as compared with the previous year, the largest monthly decrease for the year. The gas companies for the year show a decrease of nearly $200,000 and the coal companies an increase of over $100,000. This should be the end of the serious decreases in the gas department as they have been due largely to the increase in the cost of gas oil, and the contract for the current fiscal year should mean a saving of at least $200,000 in that item. Should the gas companies resume their former earning capacity, and the coal companies continue to show material increases, the total earnings of the system should be very satisfactory.

The following table shows the net earnings, applicable to dividends of subsidiaries for June and 12 months since earnings have been reported:

	June.	Year.
1907	$143,796	$1,763,030
1908	153,057	1,782,249
1909	187,446	1,896,363
1910	192,577	2,107,033
1911	201,565	2,188,325
1912	240,857	2,265,279
1913	256,827	2,604,847
1914	220,363	2,524,043

The total earnings for the year show a decrease of $80,804, and the changes by companies were as follows:

Boston Cons. Gas, dec	$160,224
N. E. Coal & Coke, inc	62,126
Federal Coal & Coke, inc	46,720
Newton & Watertown, dec	24 633
East Boston Gas, dec	10,891
N. E. Gas & Coke, inc	7,826
Boston Tow Boat, dec	1,606
Citizens of Quincy, dec	122
Total decrease	$80,804